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REPORT OF

## PRACTITIONER'S SHORT COURSE IN

# VETERINARY MEDICINE

IOWA STATE COLLEGE OF AGRICULTURE
AND MECHANIC ARTS

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Vol. I No. 1

# REPORT OF PRACTITIONER'S SHORT COURSE
# IOWA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS

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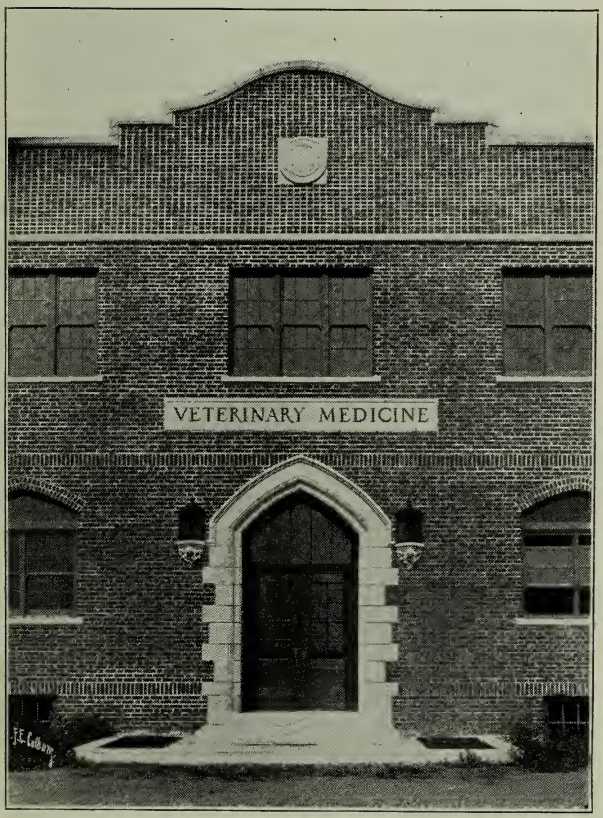


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Ohio State University, 1914.

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Ohio State University, 1912.

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B. S. A., Iowa State College, 1908. in Charge of Dairy Farm

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B. S. in Chem. Eng., University of Illinois, 1909; M. S., 1913; Ph. D., Jefferson Medical College, 1915.

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Mus. Bac., University of Kansas, 1908; A. B., 1910; LL. B., 1911; A. M., Harvard University, 1912; Ph. D., 1914.

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# PRACTITIONERS' SHORT COURSE IN VETERINARY MEDICINE.

Iowa State College of Agriculture and Mechanic Arts.

Ames, Iowa. August 16-21, 1915.

| | 8:00—10:00 | 10:00—12:00 | 1:00—3:00 | 3:00—5:00 |
|---|---|---|---|---|
| Monday | Registration | Progress in Veterinary Medicine | Physical Diagnosis—Lecture and Demonstration | Clinics or Laboratory Work |
| Tuesday | Wound Infections and Wound Pathology | Demonstration Abdominal and Pelvic Viscera | Colics of Horse—Diagnosis and Treatment | Clinic or Laboratory Work |
| Wednesday | Anatomy of Head | Surgical Diseases of Head | Mode of Action of Drugs—Pharmacological Demonstration | Clinic or Laboratory Work |
| Thursday | Anatomy of Reproductive Organs | Breeding Problems | Sterility in Cows | Clinic or Laboratory Work |
| Friday | Foot and Mouth Disease | Stomatitis—Differential Diagnosis | Serum Production with Demonstration | Clinic or Laboratory Work |
| Saturday | Pneumonias | Laboratory Work | | |

EVENING LECTURES.

Tuesday—Dairying, or other topic of general interest.
Wednesday—Municipal and rural meat inspection.
Thursday—Smoker.
Friday—Moving pictures or lantern slides.
Those wishing to do special work in Anatomy may make arrangements with Dr. Murphey.

## THE NEXT COURSE WILL BE OFFERED SEPTEMBER 4 TO 9, 1916.

The Practitioners' Short Courses in Veterinary Medicine have been instituted for the purpose of helping the busy practitioner keep in touch with the newer problems which are constantly developing along all lines of Veterinary Medicine. Some of the leading Veterinarians of the Country have been secured to help in presenting the work.

The courses so far have consisted largely of lectures and demonstrations but the laboratories of the Veterinary Division are always open to those who wish to work out special problems in which they may be interested.

It is the hope of the Veterinary Faculty to be able to interest a large number of the practitioners of the State in these courses and to encourage more and more individual work in the laboratories.

We wish to use this opportunity to announce the dates of our next course—September 4 to 9, 1916.

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# The Clinical Examination of Animals

R. R. BOLTON, AMES, IOWA.

In a very large measure the veterinary profession is dependent for its progress and for its place among the ranks of other professions upon the ability of veterinarians to read symptoms and make diagnoses.

It is a comparatively easy thing to procure and administer drugs in the treatment of diseases and to perform surgical operations, but it is a more difficult thing to recognize correctly the indications for certain medication or for certain surgical interference whereby recovery may be obtained.

There are two things with which the medical practitioner has most to do and upon which all else in the field of practical medicine depends. They should be the practitioner's specialties. They are symptoms and diagnosis. The prime requisites in the presence of every clinical case are: First, the symptoms; second, the diagnosis, so that the correct reading of symptoms and the making of correct diagnoses are fundamental to the ability of an aspirant to practice medicine.

Symptoms are observable deviations from the normal state or condition. Taking the definition of the word "symptoms" for consideration, it is clearly evident that in order to recognize and read symptoms one must necessarily cultivate his powers of observation to be able to see the least as well as the most "observable deviation." And he must know the "normal state or condition." This requires a thorough knowledge of gross and microscopical anatomy and of the physiology of each organ and part of the body.

Diagnosis is the discrimination of disease. It is the art of discerning internal changes of the body by the aid of externally visible or otherwise appreciable changes in the animal's state or condition. It is the correct recognition of disease and depends upon a correct reading of symptoms. A diagnosis consists of three things: First, the determination of the symptoms; second, the determination of the diseased organ; third, the determination of the character and the name of the disease.

In the making of diagnosis we find that something more is needed besides that which is necessary to recognize and read symptoms. We must be able to determine the diseased organ, and the character and name of the disease. For this our knowledge of pathology can not be too thorough. It requires not only a knowledge of the pathology of the various tissues of the body, but also a knowledge of the pathology of every organ and every function of the body.

The correct recognition of disease in animals is the most difficult and the most important part of veterinary medicine. It is the basis of medical treatment, surgical interference, handling and sanitary police regulations. All legal actions in veterinary medicine depend upon a correct diagnosis of disease. The success of the practitioner rests for the most part upon his ability to recognize diseases correctly.

Throughout all districts where livestock is kept there are many owners who have in their possession various remedies and methods of procedure for the relief of disease and sickness among their animals. They have besides various books which give the names and describe the causes, symptoms, course, diagnosis and treatment of all the diseases common to animals. All laymen have had more or less experience with disease among animals from which they have acquired some knowledge and have formed ideas which are usually incorrect, but very definite. The veterinarian in practice has continually to deal with laymen and stock owners who, in the presence of disease among their herds, usually exhaust the period of expectant treatment and also their knowledge of the treatment of animal diseases before they call the professional veterinarian. Such is the apparent status of the veterinary profession among laymen and the animal husbandmen of our country, and thus it will continue to be until our ability to recognize and correctly read the symptoms of disease becomes so proficient and our services so satisfactory that the practitioner will be consulted regarding the health of animals and prevention of disease as well as for the restoration of the destroyed health of animals. The maximum efficiency of practicing veterinarians and of the entire veterinary profession is to be acquired through careful study and practice of scientific methods of examination for symptoms and scientific methods of procedure for the diagnosis of diseases among animals. Scientific methods of examination will reveal all the symptoms of disease and will bring about a minimum of mistakes. This is the chief avenue by which practical veterinary medicine may be taken out of the hands of "quackery" and made preeminently a profession. The method of making a correct diagnosis is the foundation of the practice of medicine, and it is, moreover, that which makes medicine a science.

Disease is manifested by deviations from the normal condition and from the normal physiological process. Whenever we endeavor to determine the presence of disease we make comparisons between the well and the unwell, between the normal and the abnormal, between the sound and the unsound, and between the affected and the unaffected parts. We rely upon the senses of sight, touch, hearing and smelling for the correct

recognition of the symptoms of disease. We get our conception of symptoms either directly by immediate perception through the sense of sight, touch, hearing and smelling, or indirectly by modified methods of perception through the senses of sight, touch, hearing and smelling, for example, through the use of the microscope, illuminating apparatus, phonendoscopes, hammers, hoof testers, etc.

It may be relied upon that the most efficient and successful practitioner is the man who skills himself thoroughly in the knowledge of anatomy, physiology, pathology and therapeutics, and then cultivates his senses of seeing, feeling, hearing and smelling, to recognize and detect the slighest abnormalities and unsoundnesses in animals.

In the course of practice different species of animals are presented to the veterinarian for clinical examination, out of which arise certain difficulties based mainly upon differences in anatomical structure and physiological functions of the organs of different animals. The methods of examination are the same for all species, so that one who has thoroughly learned the fundamental principles underlying the methods for a proper examination will have little trouble in adapting them to all animals.

1. *Inspection:* Careful inspection is of the utmost importance in the clinical examination of all cases. It consists in an examination through the sense of sight and its thoroughness depends upon our powers of observation. Every examination should begin with inspection, in the stall or other accustomed place, or out where convenient, during which the animal should be free from excitement, fear and curiosity, if possible. The animal should first be considered as a whole and then it should be gone over with the eye, having in mind the various systems of the body with all their functions. The veterinarian should pass around the animal close enough to see clearly and thoroughly, taking precautions against being kicked and refraining from laying hands upon the animal except in so far as to gain the animal's confidence and quiet. A thorough inspection will in most cases reveal symptoms which point to the seat of the disease. The superficial changes observed under inspection are described according to the seat, extension, form, definition, color and other conditions of the surface. The size and form of superficial changes observed are described in comparison with common objects. Secretions, excretions and pathological exudates are observed and described according to quantity, color, consistency and foreign admixture.

3. *Roentgen Ray:* Examination with the Roentgen ray is a of comparatively little use. It is the inspection of internal cavities of the body made by means of mechanical apparatus

having powers of illumination. In human medicine the endoscope is used in the examination of the rectum, bladder and urethra. In veterinary medicine the most common endoscope is the laryngoscope, for the internal inspection of the larynx. American veterinarians have not made endoscopes practical because they have not yet felt the need of mechanical illuminating apparatus for examination of internal cavities.

3. *Roentgen Ray:* Examination with the Roentgen ray is recent method of inspecting the deep and thick tissues of the body by means of the photographic plate and powerful electrical illumination. The Roentgen ray is extensively used in human medicine and surgery and is being used more and more in veterinary medicine as it reaches a higher state of perfection and the cost of operating the Roentgen ray apparatus becomes less. It is especially valuable in the examination of the bones for fractures, exostoses, deformities of bone, joint dislocations, bone diseases and foreign bodies in the alimentary canal.

4. *Smelling:* After having been cultivated to perceive abnormal odors about the body the sense of smell is a very quick and satisfactory method of examination for the detection of certain symptoms. It is of importance in the examination of the evaporations from the skin, in the examination of the expired air, of the secretions and of the excretions, of pathological discharges, and of the mouth. The value of the sense of smell lies in the fact that in the decomposition of nitrogenous substances a putrid odor is given off and in the decay of bone a carious odor is emitted. A repulsive or offensive odor from fresh feces of animals speaks for some disturbance in digestion.

5. *Palpation:* By means of the sense of touch, palpation as a method of examination is made practicable. The hand and fingers possess the most acute sense of touch and they are the parts used in the palpation of the various organs, tissues and morbid changes under examination. Palpation is either direct or indirect. Direct palpation is the immediate use of the hand and fingers in sensing the various conceptions of a part. In indirect palpation the various conceptions of a part are perceived by means of a sound, probe, hammer or other instrument held in the hand during use. By palpation we make recognition of the temperature, consistency, sensitiveness, extension, position, form and movability of the part under examination. Each of these characteristics when determined bears definite symptomatic significance as to the pathological change present, and the gravity of that pathological change which should be the ready knowledge of the veterinarian.

6. *Mensuration:* Mensuration is of importance in the determination of symptoms only in so far as the exact number, or the exact size, dimensions, or weight of a part has direct

bearing upon the condition in question. We find the greatest value of mensuration in determining the temperature and the frequency of the pulse and respiration of clinical cases. The diagnosis of tuberculosis or glanders hangs largely upon the reading of the thermometer after the application of the subcutaneous or thermal test in cattle and horses for these diseases. The general condition of patients is largely determined by the reading of the thermometer after insertion in the rectum for from one to three minutes, and no clinical examination is complete without the determination of the temperature, the frequency of the pulse and of the respiration.

7. *Percussion:* Percussion is the act of striking the surface of the body so that the parts beneath are set in vibration and emit audible sounds. The instruments used are the fingers, percussion hammer and fingers, or percussion hammer and plexameter. Sounds are emitted by the vibration of the parts percussed and these sounds bear a direct relation to the physical condition of the parts vibrating, so that definite conclusions can be drawn. The principles forming the basis of percussion are: 1. Solid, airless parts of the body give forth flat sounds. 2. Air-containing organs when set in vibration produce resonant sounds. The fleshy condition of animals has a great deal to do with the value of percussion in the animal. Very fat animals can not be percussed because the body walls can not be set in vibration. Percussion is practiced in the examination of body cavities such as the facial sinuses, the thoracic cavity, the cardiac region, and the abdominal cavity. The sound emitted and the resistance that the part offers give us information concerning the thickness of the walls and the solidity of the contents.

8. *Auscultation:* Auscultation is the act of listening for internal sounds by placing the ear at the body surface. Certain organs of the body emit sounds while functioning so that by listening and hearing these sounds we obtain information concerning their condition and their function. The ear may be applied to the body wall directly, or we may hear the sounds through the medium of instruments (stethoscope, phonendoscope). Auscultation is used in the examination of the lungs, the heart, and the intestinal tract. The sounds produced by these organs while functioning are usually low so that it is necessary to have the animal in a quiet place. The normal sound of the healthy lung is known as the vesicular murmur and is produced by the respiratory air passing in and out of the air vesicles and finer air passages. It is most easily heard over the thoracic wall of the cow, cannot be heard in very fat animals, and is heard with difficulty in animals at rest.

The normal sound of a healthy heart is composed of two strokes—lub-dubb, and is caused by the sharp closing of the valves. The first sound (lub) is the weaker and caused by and marks the closing of the atrioventicular valves. The second sound (dubb) is the stronger and is caused by the closing of the semi-lunar valves in the aorta. The heart sounds can be heard in all animals. The normal sound of the intestinal tract can be heard by listening at the wall of the abdomen. It consists of a gurgling or rumbling sound and is caused by the movement of the intestinal contents along the intestinal canal. They are called peristaltic sounds.

9. *Exploratory Puncture:* This is a method by which we procure some of the contents of cavities or portions of tissue for more minute and careful examination. Exploratory puncture is used in the examination of morbid changes when other methods of examination have failed to reveal the diagnosis. It is usually supplementary to inspection and palpation. Exploratory puncture requires as complete antisepsis as possible and is employed in the diagnosis of abscesses, seromas, retention cysts, and infectious diseases by excision of an affected superficial lymph gland.

10. *Chemical Examination:* A chemical examination is employed in the examination of the secretions and excretions of the body when it becomes necessary to determine their ingredients and their composition. The examination of the urine is chiefly a chemical procedure and informs us regarding the condition and the function of the kidneys. Chemical examinations are not commonly practiced in veterinary medicine, but the need of examinations of the stomach and intestinal contents of animals is often keenly felt in practice, especially in those cases of obstinate and prolonged indigestion. The ease with which stomach juices can be procured in the large animals certainly justifies the practice of making such examinations.

Chemical procedure in the examination of the urine of animals is not commonly practiced, but there are many cases in animals from which we could obtain enlightenment by an examination of the urine.

11. *Microscopical Examination:* The microscope is a very useful instrument in the study of disease. We depend upon the revelations of the microscope for the diagnosis of many diseases, and as aids in the diagnosis of many others. How to use the microscope and all the morbid conditions requiring a microscopical examination for their determination, together with the methods of collection of material from these cases, should be common knowledge of the veterinarian. Successful practitioners are too busy to make laboratory studies and microscopi-

cal examinations of material collected from their patients for diagnosis. This fact offers no excuse, however, when confronted with the express, parcel post, and mail service of this country, and the maintenance of State diagnosis laboratories with expert technicians and diagnosticians in charge. The collection of material, its preservation, and timely shipment, require knowledge and a certain amount of time on the part of the practitioner. The microscope is required in making a thorough examination of the urine, the blood, the feces, pathological exudates and secretions, food, and drinking water. It is also necessary in diagnosing tumors, some infectious diseases (anthrax, blackleg, tuberculosis, actinomycosis) and some parasitic diseases.

12. *Diagnostic Inoculation:* This method of examination for diagnosis is somewhat limited in its application, but in those cases where it can be used it furnishes a high degree of satisfaction. It includes all the specific tests used among animals for the diagnosis of disease (tuberculin, mallein, agglutination tests, complement fixation test) and the injection of pathological exudates and tissues into laboratory animals for the reproduction of the disease in question and the determination of the diagnosis. The tuberculin and mallein reactions are so well established as proof of the presence of the disease that the Federal Government requires these tests used in all cases of interstate shipment of cattle and horses. These tests are readily mad by all veterinarian.

For the diagnosis of anthrax, blackleg, malignant edema, hemorrhagic septicemia, fowl cholera and other bacterial diseases, laboratory animals receive by injection subcutaneously or intraperitoneally, small quantities of the pathological exudates or of the diseased tissues from the bodies of suspected cases. The disease is reproduced and the diagnosis confirmed by further laboratory methods of examination. The practitioner is too much occupied to keep and care for laboratory animals, or to make animal inoculations with pathological material from suspected cases. He has no time to carry out the further observations and examinations of the laboratory animals after they have been injected, developed the disease and died. This, however, may be overcome and the busy practitioner may have all the advantages of well equipped laboratories and of proficient technicians and diagnosticians, simply by using the express, parcel post and mail systems and sending tissues for examination to the State laboratories for diagnosis.

13. *Post Mortem Examinations:* Unlike the practitioner of human medicine, the veterinarian has the opportunity to perform autopsies on most of the fatal cases in his practice. He also has the opportunity in the course of his practice, where animals sicken and die in numbers, to make an autopsy on an

animal recently dead or even to kill an animal and perform an autopsy. This affords the practitioner the very best means possible for making a diagnosis. A post mortem examination is of great value in the diagnosis of hog cholera, hemorrhagic septicemia, parasitic infestations. Many other fatal affections are positively diagnosed on post mortem examination. An autopsy should be performed upon every fatal case in which the cause of death or the diagnosis is at question.

## DISCUSSION OF DR. BOLTON'S PAPER.

Question: Can you determine diseases of the eye with the ophthalmoscope?

Dr. Bolton: You can determine the circulation of the retina of the eye, whether the retina is congested, the amount of blood supply through the back part of the eye, and in a large measure you can determine the condition of the function of the eye. By dilating the pupil and then getting your animal in proper position regarding light, you can look back and see the entrance of the optic nerves into the eye and you can see the circulation and the breaking up of the arteries and capillaries over the back part of the retina, and you can determine whether these arteries are enlarged, whether there is congestion in that part of the eye or not. Your diagnosis depends upon the clearness with which you can see these things—whether the vitreous humer is cloudy or perfectly transparent.

Question: I would like to know whether there will be any discussion in regard to the preparation and shipment of specimens to the laboratory.

Dr. Bolton: I have no knowledge as to whether there will be any discussion on that subject this week or not. Of course the veterinarian must recognize the normal and abnormal tissues —it requires some knowledge on the part of the veterinarian to select the proper tissues to send to the laboratory, and some knowledge to pack and preserve these specimens so that a satisfactory laboratory examination may be made after they get to their destination. Ice is a very good medium in which to pack any pathological tissue to send to the laboratory. In packing in ice you must consider the distance it has to go and the time of the week you sent it. If you ship it on Saturday it may lie at the express office over Sunday, and of course twenty-four or forty-eight hours makes a good deal of difference in a piece of ice, especially in the summer time. For tissues for histological examination a weak solution of formalin or glycerine will keep them, but for the detection of any bacterial agent as the cause of disease the tissues must be packed in some medium that

will have no effect upon the organism to reduce its virulence. No antiseptic ought to be used in such a case.

Question: In a case of hemorrhagic septicemia is there a better way than to put the viscera of the thoracic cavity in a bucket, seal it and then put that bucket in another bucket with ice? If there is a better method I would like to hear it.

Dr. Bolton: We have no better method to my knowledge. Has anyone a better method of taking care of material from hemorrhagic septicemia?

Question: Suppose you had a case of a dog with rabies and you wished to send it to the Iowa State College for examination—say the dog has been dead for three days and two nights, has been buried and you dig him up—would it be possible to determine the disease at that stage?

Dr. Bolton: It depends altogether on the condition of the brain of that animal. Brains of dogs come in that have been mutilated, and this makes examination impossible; other times the brain is badly decomposed and examination is impossible. It depends altogether on the condition of the brain at the time it reaches the laboratory.

Question: I had reference to an animal dying after a period of five days and then having laid over night after death and then buried in the ground, in warm weather, then dug up and sent to the laboratory for examination and pronounced "no rabies." What would you say about that?

Dr. Bolton: I could not say. I would not say anything except that I know it does depend upon the condition of the brain when it reaches the laboratory whether it can be examined or not.

Question: That would be too late for post mortem, would it not?

Dr. Bolton: Post mortem examination in case of rabies is of very little value.

Question: I would like to know if there is any cure for periodic ophthalmia?

Dr. Bolton: I think Doctor Udall can tell us something about that.

Dr. D. H. Udall (Ithaca, N. Y.): I do not know that. A certain per cent. of the cases we treat in the clinic make a recovery, and just recently I had a very interesting case in which to all appearances the eyes were normal, but the globes of the eye were soft. You could see the intra-ocular pressure was much less than normal and the lids hung down somewhat. By dilating the pupils with atropin and reflecting the light we could see in behind the vitreous bodies, the turbid bodies looked

like wisps of hay floating around in water. We injected one c. c. equal parts Lugol's solution and water directly into the fatty body behind the eye, running the needle in about a half inch. I examined the horse a week afterwards and one eye was practically all cleared up and the other was very much better, and I know of one veterinarian in the State of New York who has a great deal of faith in that treatment, uses it in all cases whether they are acute attacks or periodic or old cases in which the eye is somewhat wasted and there is some turbidity in the lens or in the vitreous body. This was injected over each eye. Following the injection swelling could be felt for a week or two, and so long as this swelling could be felt the treatment was not repeated. If after the swelling was gone the eye was still diseased the treatment was repeated.

The periodic ophthalmia I have seen is usually pronounced incurable. One attack may make the animal blind or he may have a half dozen, but nearly all of them eventually go blind. As a matter of fact, however, I know a number of horses which have been treated with eye drops, keeping the pupils dilated with atropin during the acute period, that have never gone blind. I have not used the Lugol's solution very much, but the reports are very favorable and I know in this particular case the eye cleared up in about a week. You take the ordinary Lugol's solution of iodine and mix it half and half with water, using one c. c. altogether in each eye. I do not believe it makes very much difference whether you use one c. c. or two, but in this case we used one. Dip the needle in carbolic acid and then plunge it directly down about three-quarters of an inch.

Question: Was it right over the eye?

Dr. Udall: Yes, right above the crest.

Question: In this case are you sure the diagnosis was periodic ophthalmia?

Dr. Udall: Yes, we called it periodic ophthalmia and I think we were justified, because there are not any other conditions that will cause it. He might have it from influenza and from pneumonia, but so small a per cent. of other troubles produce these changes that I think we were justified in calling them all periodic ophthalmia. I know that is the decision of the German law that turbidity in the vitreous body or in the lens after that history is classified as periodic ophthalmia.

Dr. R. R. Bolton: We have had similar results here in cases of periodic ophthalmia. We had several cases this last school year. Of course the treatment in the acute stage is largely symptomatic, but when the inflammation becomes chronic we use Lugol's solution. We use pure Lugol solution one c. c. injected into the fatty body of the eye in the temporal fossa about

an inch deep. In some cases we got apparent recovery and the man was very well satisfied. In other cases it did not clear up so well.

Question: What would you say in regard to a case that had been of perhaps two years' standing. The horse of course did not lose its entire sight, and for possibly nine months he has been the same. His eyes are glassy blue and yet he still sees. He has not seemed to get worse or better for nine months.

Dr. Bolton: At the start was it pronounced periodic ophthalmia?

Member: Yes. Would it be worth while to try this treatment in a case of that kind?

Dr. Bolton: A similar case was the one in which we tried this Lugol's solution for the first time and it is the one in which we got the best results. He had had an attack of periodic ophthalmia some months previous and the eye was still hazy blue and not clear. We used Lugol's solution and the man returned in a couple of weeks very well pleased—the eye had cleared up. Further than that I do not know whether the attack ever recurred or not.

Question: Is there any bad after effect from Lugol's solution?

Dr. Bolton: Apparently none. We have not followed all of these cases as closely as we might, but so far we have not had any bad results.

# Wound Infection and Wound Pathology

D. H. UDALL, ITHACA, N. Y.

In the consideration of wounds, as in other diseases, it is important to have a systematic grouping of the different forms. In the diagnosis of disease it is essential to have a clear conception of the group into which the one under consideration belongs. Very often in the treatment of wounds, as well as other diseases, we lose sight of the fact that the treatment varies widely as the disease progresses from one stage to another. What is indicated one day may be contra-indicated the next. and conditions which appear in different animals and appear to be identical, may respond differently to the same treatment.

In the discussion of wounds the ordinary text-book classification will be followed. In domestic animals lacerated and contused wounds are of most frequent occurrence. Punctured wounds are very common, especially in the feet, while incised wounds are comparatively infrequent. Wounds may be infected and dirty, recent or old, accidental or operative. In the treatment of wounds it is essential to consider the kind of tissue that is injured. The process of healing is influenced largely by the kind of tissue, its vascularity, and its relation to body movements. In soft parts such as the skin, mucous membrane, and muscle, the healing is comparatively rapid and complete. Injuries to the fascia is frequent, healing is slow, and troublesome complications are more liable to develop than in injured soft parts. These membraneous bands are subject to injury from punctured wounds of the upper limbs, from contused wounds of the lower limbs, and from operative wounds of the withers and poll. Wounds of the tendons, tendon-sheaths, pododerm, joints, periostium, and bone complete the chief kinds of tissue subject to accidental injury. Each of these tissues presents clinical problems and complications peculiar to itself. The process of healing of most accidental and many operative wounds leads to one or more of the wound-infection diseases, namely, suppuration, abscess, phlegmon, wound fever, septicemia, or pyemia. In accidental wounds of animals we cannot avoid infection or the most common wound infection diseases, suppuration, abscess, and phlegmon. Wound fever as used here refers to a febrile condition resulting from the resorption of aseptic animal products, such as blood clots, and removed promptly by the removal of the cause. Wound fever is the mildest general disturbance that can occur in wound infection. Septicemia refers to the resorption of the products of bacterial activity, or the resorption of the bacteria themselves, or possible their multiplication in the circulation. Septicemia is a general disease, though the in-

fection may be local, and in its treatment the removal of the local disturbance by means of irrigation, drainage, and disinfection is of primary importance. Less emphasis should be placed on symptomatic treatment by febrifuges and stimulants. The future, however, may produce some agency that will enable the body to successfully combat general infection through its influence upon the tissues that manufacture antibodies. Pyemia is a wound infection disease frequently associated with septicemia, in which metastatic abscesses develop in a part distant from the seat of the primary infection. Strangles, a disease where the infection is carried from the mucous membrane of the pharynx through the lymph channels to the submaxillary lymph glands, is an excellent example.

Other less frequent wound infection diseases are tetanus, anthrax, and malignant edema. Many other pathogenic bacteria when brought to the tissues through a wound may cause wound infection diseases. Fresh lacerated wounds of the soft parts due to barbed wire cuts and kicks heal rapidly becaues the injured tissues (skin, subcutis) are highly vascular.

In the healing of all wounds nature's method is fundamentally the same. In fresh wounds the first important act is the control of hemorrhage. Capillary and parenchymatous bleeding stop in a few minutes, hemorrhage from veins may continue for some time, but horses seldom bleed to death.

Excessive bleeding finally leads to lowering of blood pressure with the formation of a clot. Parenchymatous hemorrhage may be suppressed with warm solutions of creolin; in the operative parenchymatous hemorrhage of fistulous withers and poll evil a weak solution of creolin has a marked hemostatic influence. Adrenalin applied locally is a very useful hemostat. Some clinicians consider that adrenalin per vein has a marked effect upon the control of hemorrhage, though experimental work performed by physiologists does not support this opinion. This, however, is not the only example where clinical experience fails to harmonize with experimental data. Bleeding from large vessels is controlled with artery forceps, or by means of a firm tampon when the vessel is beyond reach.

After hemorrhage is stopped all blood clots should be removed. Blood has an antiseptic action, but it does not follow that blood clots in a wound promote healing; they have been mentioned as one of the causes of wound fever. The breaking down process begins in a few hours, and resorption of the products induces a febrile condition; it is essential, therefore, that the wound be perfectly clean. In cleansing a wound there is often a failure to differentiate between cleansing and disinfection. In the removal of pus, blood clots, or other material a non-irritating agent should be used. So far as possible dry

cleansing is preferable, next to this warm solutions of carbonate of soda, or salt are employed. Salt and soda are alkaline and tend to dissolve exudates while many antiseptics like creolin or corrosive sublimate coagulate the albumen and prevent its easy removal. Fresh wounds do not require much disinfection unless badly contaminated, experimental results, however, have shown that the application of tincture of iodin or even pure carbolic acid to the surface of a fresh clean wound does not delay healing; it is the continued and repeated use of irritating disinfectants that plays havoc. Tincture of iodin on a fresh wound is of value because it leaves a protective covering over the surface. A similar result may be obtained from iodoform, boric acid, or a combination of equal parts boric acid and salicylic acid.

After the control of hemorrhage the vessel brings to the part an increased amount of blood serum which serves as an antiseptic. The process of healing is essentially an inflammation; if injury to the tissue is not too extensive, and if bacteria are kept out, the inflammatory process is mild. Within a few hours after the injury new cells from the connective tissue cells of the part are formed, and the kind of tissue injured determines the rapidity of healing. If the part is rich in loose connective tissue (subcutis) the process is rapid; if it is tendinous repair is not so rapid. Within twenty-fours hours after the tissue is injured, if it is carefully protected, there forms a layer of granulation tissue on the surface, and if there is no mechanical insult to break it up, and too strong disinfectants are not used, this serves to protect against entrance into the tissues and absorption by the circulation of pathogenic bacteria. In accidental wounds the process of suppuration practically always develops, and almost within this generation a wound was not supposed to heal properly unless it did suppurate.

Newly-formed minute blood vessels develop with the new connective tissue cells giving the tissue under repair a red granular appearance. When healing proceeds regularly the gaping space is filled with a highly vascular granulation tissue; the cells then become more fibrous, the vessels are compressed and obliterated, and the shrinking process finally leaves a scar that may vanish under a new covering of epithelium.

Numerous influences may delay the normal repair of wounds. Granulation tissue may form in excessive amounts ("proud flesh") because of irritation from bacteria, excessive use of irritating disinfectants, contamination with filth, lack of rest, or decomposing wound secretions held on the tissues by bandages or otherwise. If the injury is located so that secretions remain in the wound they soon decompose and putrefy and irritating products are formed that may destroy the granulations

faster than they can form, and the result is an ulcer—a wound that tends not to heal. It is very important, whatever line of treatment is followed, that the wound be cleansed in such a way that the secretions and pus formed are not left in contact with the wound. In many lacerated wounds this can be accomplished with the use of dusting powders that have a great absorbing capacity. I was very much interested in a recent description in the British Medical Journal of the open wound method of treatment of injuries to soldiers; daily removal of the secretions with the use of a minimum of moisture, and the use of dusting powders (charcoal, equal parts of boric acid and salicylic acid—"Borsal") seems to be much favored. In many cases of granulating wounds I have used a dusting powder composed of equal parts charcoal and air-slaked lime; this combination was inexpensive and gave good results, but did not appeal to me as a very refined product. But since both lime and charcoal are both advocated in army and navy journals it is obvious that their use by veterinarians may be practiced with a clear conscience. After a wound is freed from infection our chief problem is to provide for the removal or absorption of the wound secretions. If the secretions are quite abundant the wound should be cleansed at least once daily with a minimum amount of saline solution, or hydrogen peroxid, and if disinfection seems necessary apply that distinct from irrigation. If the granulations are irregular, if they are dark in color, if pus is infiltrated in the surface, the wound needs disinfecting. Infection within the tissue should be reached. One may use a disinfectant like tincture of iodin, or cauterize the granulations with a stick of nitrate of silver, or use a ten per cent solution of nitrate of silver, or touch the granulations with pure carbolic acid followed with alcohol, or remove the superficial unhealthy layer with a curet.

When the granulations become excessive astringents to constrict the vessels are indicated, or removal of some of the tissues may be required. Such astringents as copper sulphate, chlorid of zinc, or nitrate of silver are useful, but the thermocautery is usually better, or when they project far above the surface of the wound they may be sliced off with a sharp scalpel and then cauterized and covered with tannic acid. The point of a cautery causes retraction of the scar tissue within twenty-four hours and changes the entire appearance of the wound.

Wounds may be treated by the open wound method, or covered with bandages, but in either case the tissues should be protected with a covering during the first twenty-four hours when granulations have had time to form a protective covering. Then if the wound is kept quiet and not irritated it is in better condition to care for itself, infection cannot break through into

the circulation. Gauze is preferable to cotton as a dressing since it is a much better absorbent of wound exudates.

There is another group of wounds where in addition to a break in the continuity of the tissue there is the effect of a blow —a contusion. The blood vessels have been ruptured, the tissues bruised, and bleeding occurs directly into them, causing a swelling. If the bruised and wounded tissues are covered with fascia the pressure becomes marked, and there is increased danger from the resorption of exudates. In the treatment of recent contused wounds one should use an agent that relaxes the tissues, relieves pressure on the nerves, hastens repair, and promotes resorption of the broken down products. For this purpose the present tendency is to apply heat, and nearly all acute painful inflammatory conditions respond more favorably to heat than to cold. It depends somewhat on the intensity of the inflammation and the amount of exudate to be resorbed. The general effect of cold is to constrict the blood vessels and favor the retention of broken down products in the tissues rather than to promote their resorption, so that in recent contusions hot packs are usually preferable. The difficulty is in keeping the packs hot and in position. We may use surgeon's cotton under a bandage and pour the hot antiseptic beneath, repeating this at frequent intervals. In the application of heat its action may be prolonged by covering the cotton with some impermeable material like rubber sheeting or heavy parchment paper; first cover with cotton, then cover with parchment paper or rubber sheeting, and enclose the whole in flannel bandages. In place of a hot antiseptic solution the cotton may be saturated with alcohol by pouring it in around the top—alcohol bandage—and repeating three or four times a day, or every three or four hours. An alcohol bandage may be applied to contused wounds, recent contusions, strained tendons, sprained joints, or where there is present an acute inflammation with symptoms of heat and pain. An alcohol bandage seems to be a resorbent of great value in acute conditions. Contused wounds are very liable to suppurate, to lead to the formation of abscesses in neighboring parts, or to the development of a phlegmon.

Punctured wounds offer a special problem in the form of drainage, since infection is carried deep into the tissues and may lodge beneath the fascia. In recent punctured wounds hot antiseptic packs are indicated. If in a few hours the pain and swelling increases it usually indicates that infection is spreading beneath the fascia. The proper treatment of such cases must be determined by the intensity of local reaction and constitutional symptoms—pulse, fever, etc. An early incision carried to the depth of the puncture may prevent a suppurative infiltration with necrosis and septicemia.

Wounds and wound infection diseases of the pododerm are similar to those of the skin, the hoof capsule corresponding to the epidermis, and the pododerm to the true skin. As soon as possible after the pododerm has been wounded pressure on the tissue should be avoided by pareing thin the overlying horn. If infection then develops the soft tissues are less rigidly compressed and a small amount of swelling may be possible; this tends to localize the process and prevent suppurative infiltration, it also favors drainage.

Punctures of the pododerm near the point of the frog are specially troublesome. The fatty frog is an excellent tissue for the spread of suppurative infiltration, and the fascia between the fatty frog and the overlying perforans tendon easily becomes necrotic when exposed to infection. The dressings of suppurating wounds of the pododerm should be changed at least once daily, and every possible effort should be made to check suppuration. The Paquelin cautery, or silver nitrate stick followed by an abundance of absorbent powder (iodoform) and an antiseptic gauze tampon soaked in tincture of iodine or a ten per cent solution of formalin are of special value in disinfecting this loose connective tissue. The formalin pack, however, should not be used repeatedly, from one to three times is usually sufficient. In severe cases it may be necessary to resort to a curet for removal of the necrotic shreds and infiltrated tissue.

Injuries to the pododerm of the sole are less serious. When the resultant suppuration is superficial, indicated by thin black pus, a small opening for drainage and the application of gauze dressing is sufficient. With a deeper inflammation of the pododerm, indicated by yellow pus and an undermining of the horn, the suppurative area should be thoroughly exposed by removal of all of the undermined horn. Persistent suppurations may be checked by one or two applications of a gauze pack soaked in a ten per cent solution of formalin, and followed with dry dressings of tannin. Pus mixed with gas from a suppruative pododermatitis is an indication of necrosis of the pododerm.

Tendon wounds are often slow in healing because of the non-vascularity of tendon tissue. Injuries to tendons are repaired with connective tissue, a weaker kind of material than the original structure. Accidental wounds of tendon sheaths and joints are very liable to become infected, when the prognosis is bad: this is especially true of flexor tendon sheaths, and joints having great freedom of action—tendon sheaths of the perforans, carpal, tarsal, fetlock, and pedal joints. Infection of fresh injuries to joints and tendon sheaths may be avoided occasionally by thoroughly cleansing and disinfecting the external wound, and covering with an occlusive antiseptic dressing. After the

cavity is once infected and suppurating permanent irrigation with slaine solutions, or a weak solution of a corrosive sublimate, is indicated. Recovery in some cases has followed the injection of pure creolin, or a mixture of iodin and glycerin and tincture of iodin 1:3. In human surgery free opening of suppurating joints and tendon sheaths is advised, and this method is occasionally successful in the horse when applied to the coronary joint or the perforans tendon sheath at the hock, in the latter place the tendon is also separated to provide rest.

# Demonstration of Abdominal and Pelvic Viscera of Horse and Ox on Partially Dissected Subjects

(3 Horses, 2 Cows.)

H. S. MURPHEY, AMES, IOWA.

I want to call your attention in the first place to some points in the skeleton used for topographic landmarks and location of points. First, the lumbar vertebrae, counted from before backward, next the last pair of ribs in the skeleton. Again from the outside we refer to traverse plans through the ribs and through the external angle of the ilium and the shaft of the ilium. I call your attention to the fact that the horse, compared with the ox, is short-coupled and this should be considered in taking the last rib and external angle of the ilium for landmarks. A transverse plane through the last pair of ribs cuts through the second or third lumbar vertebra.

Now, to briefly enumerate the digestive organs, following the course of the fool. First, there are the mouth, pharynx, esophagus, stomach, and the small intestine which is arbitrarily divided into three parts, the duodenum, the jejunum, and the eleum. The duodenum is the fixed portion with a short mesentery; following that we have the long mesenteric portion, the jejunum, and ileum which cannot be separated one from the other except the terminal portion called the ileum which has a thick wall; next is the cecum, the large cul de sac in the right flank; from here the large colon divided in four branches—right ventral, left ventral, left dorsal, and right dorsal—and three flexures, the supra sternal, the pelvic, and the diaphragmatic between the branches in the order given, the fourth colon terminal part where the fourth colon passes into the floating colon, may be called the transverse colon, the floating colon and then the rectum.

Allow me to call your attention to the shape of the abdominal cavity as we find it. The cavity is oblique, the long axis goes from behind at the center of the pelvic inlet downward and forward or from this point upward and backward. It is frequently described as dome-shaped anteriorly, and you see here the stomach—which, since the other viscera have been removed, has dropped downward and backward, here the omentum and here the duodenum, the short-mesenteric portion of the small intestine which comes backward to the right of the fourth colon and under the liver which is attached directly to the

diaphragm, then the transverse portion which passes across from right to left back of the base of the cecum, approximately under the first lumbar vertebra.

Other fixed points used for topographical purposes are the kidneys. The right kidney is practically constant in position under the last two ribs and the transverse process of the first lumbar vertebra. The left kidney is subject to a slight amount of variation, but in most cases is under the last rib and transverse processes of the first two lumbar vertebrae.

In the next subject we will show you the right kidney in position. The seventeenth rib is removed but the eighteenth is present. Immediately behind it we have the last portion of the duodenum passing across from right to left behind the base of the cecum. In some cases we may have coils of the small colon behind the cecum; commonly the cecum occupies the entire right flank. I lay down the diaphragm and lift up the liver to show you some more of the duodenum as it comes upward and backward under the liver above and to the right of the right colon. The stomach we will see from the other side. You will notice here as we remove the lung that the lung itself lies over a considerable amount of the abdominal viscera. We lay down the diaphragm and find the liver at this point. In the young animal the right lobe of the liver is larger, in the old animal the left lobe. The left kidney is under the last rib and the first and second lumbar vertebrae.

The stomach lies mostly to the left of the median plane in contact with the liver and the diaphragm. Immediately back of the stomach, when in normal position, we find the spleen, which follows the greater curvature of the stomach and also follows approximately the line of the costal arch. Frequently the spleen is far enough beyond the last rib that we may say it is under the anterior part of the paralumbar fossa. It is immediately under the last rib in this case. Now I will push the spleen forward—and we have cut the omentum here in order to demonstrate the point where the large colon goes over into the floating colon or the "transverse colon" as we call it. At this point there is a marked constriction. Topographically this lies under the last two or three ribs, medial to the spleen, back of the stomach, in front of and below the left kidney. At this point we have the colic mesentery which supports the small colon. Later we shall take this off step by step so that we may examine the underlying structures.

I want to call your attention to the fact that in palpation the hand must be passed into the rectum and far enough forward to get into the small or floating colon where the mesentery is long. After the hand is passed in, in that manner the fingers are spread out fan-shaped and pulled backward carrying the

gut with them. You must go forward then along the left wall on the outside of this portion of the mesentery which suspends the floating colon if you are to locate this point (terminal part of great colon) for impaction. The last rib and the kidney are the structures which you must locate. Then as you push along the spleen and get to this point you will find the omentum which passes from the spleen across to the last part of the transverse colon to the beginning of the floating colon. This represents the free edge of the gut. You have to palpate from that.

Now the other points we wanted to show you on this specimen are the muscles and the position of the rectum. When we remove the sacrosciatic ligament covering this space as can be seen on this specimen, immediately underneath lies the coccygeus muscle, the depressor of the tail. Under that lies the retractor of the anus which passes under the external sphincter of the anus at this point. We have here then the suspensory ligament of the anus which passes around the anus as a loop and in the female fuses with the sphincter of the vulva; in the male it becomes the retractor penis. This shows some of the internal pudic vessels coming back to the vagina and vulva. The position of the peritoneum varies with a number of factors. If the rectum is full the peritoneum is pushed forward so that the peritoneal cavity does not come back farther than the sacral promontory. If the rectum is empty it will come back farther, and again it will come back when the colon is distended with gas pushing it backward; and it is backward of course in a case of labor when the rectum is empty. Immediately under the rectum lies the vagina. I have separated this as far as the anterior extent of the retroperitoneal space. We will follow this further in another demonstration after we have finished the digestive organs.

In this subject, a gelding, we have cut the internal pudic artery at its point of entrance into the crura of the penis. At the Thursday period I can probably show it better, but these two arteries come very close together in the root of the penis Another interesting thing from a topographic standpoint is the small vein which goes from the tail across the rectum fusing with the internal pudic vein. The obturator artery and nerve are shown at this point. You will notice a large branch of this artery also coming back into the root of the penis.

You will see that we have divided this horse thru the withers. Of course this has dropped somewhat from its own weight. I remove the thoracic viscera, and we find an anterior view of the diaphragm, showing why we get the dome shape seen in the first specimen. We see here that the sharp border of the lung lies in this narrow space between the parietal and di-

aphragmatic pleura, especially around the attachment to the diaphragm. I can demonstrate the attachment of the diaphragm (the muscular portion) to the upper part of the last rib. The attachment is oblique from here to the distal end of the tenth rib. From the tenth the attachment follows the costal cartilage to its attachment to the sternum. In removing the diaphragm we have a chance to examine the structures from in front, and first we have the liver, which in this old horse is almost entirely to the left. I should have called your attention to the fact that the heart and pericardium are directly against the diaphragm at this point. There is a part of the pericardium left here on the sternum. First we have the liver, and we shall remove that to see the underlying structures. Now you see that it has been in contact with the stomach on one side and the fourth branch of the colon on the other. You see the spleen here in position as we had it before. We have the mesentery cut here again so that we can see the transverse colon. You will see a part of the pancreas at this point, this is the terminal part of the esophagus. I push that over to see the lesser curve of the stomach and the S-shaped curve of the duodenum. The first curve is ventral, the second is dorsal, which marks the point of entrance of the bile and pancreatic ducts. We have a part of the pancreas exposed, the duodenal angle of the pancreas, the pancreatic duct is split. My finger is in the pancreatic duct. Now we can follow the duodenum backward on the right side to the point where it turns across from right to left behind the base of the cecum, approximately ventral to the first lumbar vertebra, but we are unable to follow it for the colic mesentery which I demonstrated on the other subject. So far as the position of the small intestine and the floating colon is concerned, they are usually in coils in the upper part of the left flank.

You see what is under the stomach at this point, this is the diaphragmatic flexure, this is the third branch of the colon, and here it turns across. This last part of the colon is called the right dorsal. You will notice the omentum passing from the stomach across at this point to the floating colon. This marks the constriction (transverse colon) previously referred to in the method of palpation. I shall remove these structures so it can be seen further.

Now we have a part of the liver left here. At this point we have the posterior vena cava. Immediately in contact with that for a short distance is the portal vein—the vena cava to my right and the portal vein to my left. I shall lay these up so we can see the transverse portion of the colon. I have left the pancreas here. It was in contact with the duodenum and with the stomach and with the fourth colon, the transverse por-

tion. This is not the normal color of the pancreas; it becomes darker in the cadaver. The normal color is pinkish.

Now we can see the transverse colon and the large dilatation in the fourth branch. I believe the descriptions say this may be as much as twenty inches in diameter. The remarkable thing is the constriction as it becomes the floating colon. It is practically constant in position under the sixteenth and seventeenth ribs anterior and ventral and anterior to the left kidney and medial to the spleen. We have here the terminal part of the duodenum. We call it the jejuno-ilium from this point. This is the pelvic flexure of the great colon and you will notice the constriction after the pelvic flexure goes into the third branch. Commonly this lies dorsal, but it may lie lateral and to the left or to the right. This portion of the colon is free at the entrance of the pelvis and it may be to the left side and anterior below the brim of the pelvis, it may be pushed backward and into the right side of the pelvis, or it may be nearly median in position. In order to follow the mesentery we shall push this forward. Before I remove this we can see the diaphragmatic flexure, and as I lift it up we have under it the suprasternal flexure. In other words, we can demonstrate now all the branches of the colon. This is the right ventral which passes across at the suprasternal flexure into the left ventral which brings it by the pelvic flexure into the left dorsal which passes forward to the diaphragmatic flexure and becomes the fourth colon which as the "transverse colon," passes across from right to left in front of the base of the cecum behind the stomach under the sixteenth and seventeenth ribs and becomes the floating colon. If we draw out the floating colon from this point, which is the fixed portion, it will show the length of the mesentery. This is usually intermingled with coils of the small intestine. You see here where it goes over into the rectum at the pelvic inlet under the sacral promontory, and you can see where the mesorectum, which is short, becomes long, up to twenty and even twenty-four inches as you go from behind foward to the colic mesentery. This one is perhaps twenty-six inches at this point. This is the portion which I spoke of previously in palpation, that you should come between this mesentery and the lateral wall if you want to get forward to the point where you can palpate the termination of the fourth colon (transverse portion) and the beginning of the floating colon.

I should have stated at the beginning that when horses die their lungs are in a state of expiration, that is, the diaphragm is forward and relaxed. Of course the viscera must move with respiration. Now from this point you can see one of the peculiarities in the short mesentery of the rectum in the fact

that we have the urinary bladder directly under the rectum, and it is not easily palpated unless you get forward into the floating colon and come back. Now we can follow the duodenum back on the right side under the first lumbar vertebra across to the left side where the mesentery increases in length as we demonstrated at this point. That gives us a chance to remove the small intestines and examine the mesenteric root. Now we have the terminal portion of the small intestine at the point it enters the lesser curvature of the cecum. This portion extends usually dorsal; from the abdominal floor it comes up to the lesser curve of the cecum, as you see at this point. It can be noted here that the gut is not in the edge of the mesentery but the fold passes across to the cecum.

In regard to the topographic position with the animal on its back, the classic description is that there may be a small amount of intestine between the right and left colons on the ventral floor. Our records show about three sub-divisions. In the first the small intestine and small colon is between the right and left upper colon; in one-third of the cases the small intestine and small colon pass directly between the right and left and lie on the floor and have the left colon pushed dorsal; in the third the small intestine lies to the left of the left colon, in other words, on the left lateral wall. I should have stated that the anterior great mesenteric root is to the left of the median plane under the first and second lumbar vertebra. This will give us a chance to examine the cecum, which lies in the right flank usually and is filled with fluid contents. The upper portion is distended with gas so that it occupies most of the right flank. In the dissecting room subjects we usually have a considerable amount of bloating and it is impossible to hold this in correct position. It is attached under the last rib and first lumbar vertebra and it makes a large curve which extends upward and backward and downward along the floor and the apex lies toward the xiphoid cartilage, usually ten or twelve inches behind that point, and since the free end is not attached it is subject to some variations. The attached portion is fixed. It lies under the right kidney and usually it is filled with gas so that approach to the right kidney is difficult.

The genital organs lie immediately under the rectum. In this subject you can see the vas deferens, the prostate gland, and beyond that the bulbourethral gland. The bladder is partly pelvic and partly abdominal in position.

We come foward in this subject about to the body of the uterus. We have to go outward and forward from the body on this side. Unfortunately we cut through the left colon. The ovaries are located approximately in a transverse plane

through the external angles of the ilium. From this subject the rectum has been removed so that a number of things can be demonstrated. One of the things is the marked constriction at the anterior peritoneal portion which lies approximately under the sacral promontory. This shows the peritoneal and non-peritoneal portion of the rectum very well; shows that two-thirds at least is retro-peritoneal. In this subject the vagina has been opened from above to show the position of the urethral orifice and to show the position of the os. Some of the structures which can be seen anteriorly are the branches of the pudic vessels which go to the vagina. We can see above and in front the principal branches of the aorta. On this specimen we can see the branches of the internal pudic artery which go to both the vagina and the posterior part of the uterus. In front and below this we see the obturator vessels and when we follow them up we find the large branches of the aorta and their satellite veins going to the posterior vena cava. We will now go to the ox.

On the skeleton of the ox one of the first things we notice is the lumbar vertebra. The ossa coxarum does not come so far forward compared with that of the horse. We also notice that the lumbar vertebra themselves are very long, so we say that the ox is long coupled, much longer than the horse, the distance between the last rib and the external angle of the ilium being much greater. The sacrum is curved and drops downward more posteriorly, the tuber ischii is very prominent and the lateral wall of the pelvic cavity is largely bone, the ischium being higher than in the horse.

We want to show a number of things about the udder of the cow: First, the obliquity from behind forward of the superior surface, as it is moulded on the abdominal muscles; second, the lateral suspensory ligament not usually described. Notice that this covers the supra mammary lymph node. In the cow instead of several lymph nodes as in the mare we find one on either side, occasionally a third one which may be on the right or left or between the right and left lymph node. In case there is a third one it is usually small. The arterial blood supply reaching the udder, comes through the inguinal canal. The venous circulation differs from that of the mare by showing in addition to the external pudic an anterior vein, the subcutaneous abdominal vein which is sometimes called the milk vein, passing along in the abdominal muscles to the thorax where it becomes the internal thoracic or mammary vein (as described in man), in addition there is a third one which passes upward and backward as the perineal vein. In the mare the principal circulation is through the external pudic and subpudic vein, the latter is absent in the ox. The venous arrange-

ment then is essentially different. There is a suspensory ligament median which Sisson describes as being easily separable into right and left portions by areolar connective tissue. I have not found it easily separable; the two parts are usually fused with each other.

In regard to the subdivisions of the digestive tract, we find a number of differences in the ox. In the first place the esophagus is much greater in diameter and has a complete wall of voluntary muscle. The stomach is divided into a number of compartments. According to the point of entrance of food and supposed passage in ruminants, this is the first compartment, the rumen; the second is the reticulum; the third the omasum and the fourth the abomasum or true stomach. We call it the true stomach on account of the fact that the digestive glands are located here, the previous portions being non-glandular. The small intestine is approximately 120 feet long in the ox, 70 feet in the horse. The large intestine is approximately 30 feet long and differs from that of the horse by lacking longitudinal bands and cross constrictions. The rumen occupies approximately the left half of the abdominal cavity. There is a portion anteriorly occupied by the reticulum. It extends along the left side in contact with the left abdominal wall from the external angle of the ilium forward, except the small portion occupied by the spleen. On the right it is in contact with the omasum and abomasum, the liver and large intestine principally. Sisson says that the small intestine lies ventral and to the right and may come around behind the posterior part of the rumen. In practically all of our subjects we find the small intestine ventral to the rumen and showing on the left side as seen here. We also find the abomasum ventral to the anterior part. In this subject we have removed the contents of the rumen and reticulum. You will notice the diaphragm is near the vertebrae at this point. In removing the left lung notice there is only a small portion posterior to the heart—the pleura is to the left of the median plane. I lay that down and we can see the mediastinal lobe of the right lung. Notice that it is in direct contact with the diaphragm for a considerable distance. The rumen is divided into dorsal and ventral blind sacs (Sisson). As a matter of fact the ventral sac as we have found it is ventral and to the right of the dorsal. These are the pillars separating the superior and inferior compartments. Each of these is again subdivided. I want you to notice here that in passing forward from behind you would have to pass over this pillar and then over a second pillar between the rumen and the reticulum. That is called the rumen reticular fold. In the other specimen we have dissected away the most of the rumen and the reticulum. You see the esophageal groove at this point. Notice the reticulum lies in

contract with the diaphragm and that the lung above, and pericardial sac below are just in front of that.

We have the right kidney here. Its position does not differ much from that of the horse. The left kidney can be seen better in the other specimen and it lies behind the right kidney. We have here the duodenum. We will show it on the next specimen and we shall then show some of the deeper structures. We have the gall bladder at this point. It is rather remarkable that these were the first two cases we have had in the dissecting room in which the gall bladder was not under (medial to) the diaphragm. It is posterior and ventral in both cases. Commonly it is higher and farther forward.

We have removed all of the rumen and reticulum in this subject. Necessarily the visceral organs are dropped somewhat. The cecum has its blind end partly posterior and to the left in the ox. In this case it was in the pelvic cavity dorsal to the uterus in the rectovaginal pouch. The common position for it is at the pelvic inlet. We have the diaphragm here which we are laying back. Notice that the esophagus passes between the right and left crura, and in dissecting room subjects we always find this constriction which is probably present in the living animal also. The diaphragmatic lobe of the right lung is shown here and by pushing the diaphragm back we show the contact with the reticulum at this point. The esophageal groove faces first backward, then to the left then nearly forward, and finally opens out of the reticulum into the omasum at this point backward and to the right. Now I can pass my finger far enough through the omasal groove to get into the abomasum. My finger is in the so-called omasal groove which is a continuation of the esophagal groove through the omasum to the abomasum. The duodenum is shown on the other side passing backward and turning across from right to left. Here we trace it forward and find it going over into the jejuno-ileum. If we follow this we shall find that the small intestine is at the edge of the mesentery and the large intestine is arranged above at this point in the centrifugal and centripetal portions above the small intestine. I do not know whether there are any foreign bodies in there or not. There is a nail. Notice that it is going in the wrong direction—seems to go back into the omasum. Commonly of course foreign bodies take the opposite direction, due to the movement of diaphragm.

Now on the right side we see the ribs laid down to show the attachment of the diaphragm; we see the gall bladder and the liver which is against the right kidney, but we do not find the liver on the left side in the ox. It has practically no attachment to the right. The liver is in contact here with the diaphragm. Under the liver we have the omasum in front and the reticulum

to the left. Median to, ventral, and under the omasum we have the abomasum, and it makes a curvature here before going into the duodenum. Here we have the duodenum going backward again and we have taken a window out here to show the point of entrance of the pancreatic duct. The pancreatic duct in the ox enters the duodenum several inches posterior to the bile duct. I would like to show you also the rectum at this point. Notice the short mesentery as it goes over into the colon. It passes forward and to the left of the principal portion of the mesentery. It is practically impossible to palpate anything through the rectum of the ox. You can palpate the genital organs, the blind sac of rumen, the left kidney, seldom the right. There is no mesentery to allow freedom of movement as in the horse. Notice also that the rectum turns to the right of the median plane as it passes forward into the colon. From this side you can see the left kidney which is usually behind the right and pushed more or less to the right of the median plane by the rumen. Under the rectum we have the genital organs. Thursday morning I will have these removed so we can go further with the examination of the interior than this morning.

The vaginal glands in the cow are comparatively large and they open each one on two ducts in a fossa which is just inside the pelvic cavity, lateral to the opening of the external urethral orifice of vagina. There is practically no fornix around the os in the cow as in the mare. Notice the rigidity of the folds of the mucous membrane here. Now on the right we have the last portion of the omentum at this point, the duodenum passes forward and makes more or less of a curve before turning backward. The bile duct enters at this point. The pancreatic duct enters farther back. I wish you to notice particularly that this lies above the sternum and to the right side and that the abomasum is not against the right wall, but rather the omasum.

I will now show the duodenal papillus and the bile duct of the horse just a few inches from the pylorus.

These specimens will be out here for further examination, and if I can be of any assistance to you I will be very glad. I intended to announce at the first of the period that the college book store has some of the second edition of Sisson's anatomy. Are there any questions?

# Colic in the Horse*

D. H. UDALL, DEPARTMENT OF MEDICINE, CORNELL UNIVERSITY.

In a restricted sense the term colic means pain in any part of the stomach or intestines. It is not the name of a disease, though usually defined as such (Reeks, Wall), but a secondary symptom induced by compression of the ends of the sensitive nerves through spasmodic contractions of involuntary muscles of the intestines (Hutyra & Marek, Nothnagel). Spasmodic contractions of involuntary muscle fibres of other organs also induce colic pains (uterus, bladder, urethra, gall duct). This article does not include so-called "false colic" (pain in the peritoneum, spleen, etc.) or so-called "symptomatic colic" (infectious diseases, poisons, primary gastro-enteritis).

Recently there has been some criticism of the customary use of the term colic. Hutyra and Marek in particular call attention to the absurdity of its retention in classifications from either a clinical or a scientific standpoint. They maintain that there is no reason for the retention of a single word to cover all the diseases of a region of such importance; that such a custom has a tendency to lead to a similar uniform treatment for unlike diseases, and that in the light of our present knowledge and methods of differential diagnosis its use in classifications is now unjustified.

Classification and occurrence. The following classification includes only those diseases of the alimentary tract to which the term colic as used in strict sense may be applied. It excludes poisons, complications of infectious diseases, infectious diseases affecting principally the digestive tract, and primary gastro-enteritis (symptomatic colic of Froehner). Since all colic is symptomatic the term is not free from objection.

### A. Catarrhal and Functional Indigestions.

1. *Catarrhal Spasm of the Small Intestines* (spasmodic, chilling, nervous, rheumatic colic). Thirty-five per cent. of clinical cases H. & M.)

2. *Acute distentions.* a. Gastric distentions (gastric indigestion, overfeeding, tympany). Eleven to twenty-one per cent of clinical cases (H. & M.); 18 per cent of 834 autopsies had gastric rupture (Wall); 10 per cent of 1,487 clinical cases in the Berlin clinic, one-third of which were primary (Behren).

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b. Intestinal gaseous distentions (flatulent colic, tympany). Two to fifteen per cent of clinical cases (H. & M.); 2 per cent of 834 autopsies (Wall).

3. *Intestinal Accumulations and Impactions* (food, feces).

a. Small intestines. Forty-four per cent of 722 clinical cases (Behren); 3 per cent of 834 autopsies (Wall). In 109 cases of primary intestinal impaction at the Budapest clinic in 1906-07 the ileum was involved in 13, the duodenum in 3. In 386 fatal cases in the Berlin clinic during 1897-1906 the ileum was involved in 96, the duodenum in 13, the jejunum in 2.

b. Large intestine. Thirty-two per cent of 722 clinical cases (Behren); 1.5 per cent of 834 autopsies (Wall). In the 386 autopsies at the Berlin clinic the colon was involved in 185, the caecum in 80, and the rectum in 10. In the 109 cases at the Budapest clinic the colon was involved in 90, the caecum in 3, and the rectum in 1.

### B. Displacements, Obstructions and Strictures.

1. *Volvulus and Torsion* occur in from 2.5 to 5 per cent of all clinical cases (H. & M.) In the years 1892 to 1906 it comprised 4.1 per cent of 61,248 cases of colic in the Prussian army; 1.92 per cent were volvulus of the small intestine, 2.06 per cent torsion of the colon, .13 per cent torsion of the caecum. In the same period it comprised 33.8 per cent of 7,458 autopsies; 15.8 per cent of the small intestines, 17 per cent of the large. It comprised 38.2 per cent of 834 autopsies (Wall). It is most common in military and draft horses (H. & M.), and is usually found in the terminal end of the ileum (Behren).

2. *Incarcerations* comprise 1 to 1.5 per cent of clinical cases, and 5 to 13 per cent of autopsies (H. & M.); 21.5 per cent of 854 autopsies (Wall); 1.56 per cent of 64,248 clinical cases, and 12.8 per cent of 7,458 autopsies in the Prussian army. Hernias of the diaphragm and mesentery, the foramen of Winslow, and fibrous bands are the usual seats of compression.

3. *Intestinal obstruction* is relatively rare. Three-tenths per cent in the Prussian army in 15 years; at Budapest from .2 to .7 per cent of colic; 1 per cent of 854 autopsies (Wall).

4. *Intestinal stricture* is rare, about the same as obstruction (H. & M.); .9 per cent of 854 autopsies (Wall). According to Behren cicatricial stenoses of the ileum are very common and a frequent cause of food accumulations.

### C. Thrombosis and Embolism.

In the clinics at Berlin and Dresden and in the Prussian army thrombotic infarcts are found in the intestinal walls in 5 to 6

per cent of horses that have died of colic. In Budapest the per cent is 32, while in Stockholm, where the water is filtered, Wall found the infection in only 1.2 per cent of 854 autopsies. The affection is widely variable in distribution and is more common in the country.

### D. Gastro-enteritis.

Wall found enteritis in 1.2 per cent of autopsies.

A comparison of the observations of different writers shows greater uniformity of expression in the groups where the fatalities are high, and where the diagnoses are verified by autopsies. In those forms of indigestion where recovery is the rule and the cases are diagnosed by clinical symptoms there are wide variations in the diagnosis. For example, in group A Hutyra and Marek include 50 to 80 per cent of all colic under the first two headings, while Froehner and Behren include 76 per cent of 722 clinical cases under group 3. It is not probable that such differences occur under conditions that are so similar. This apparent discrepancy is due partly to the absence of distinct lines of demarcation between the diseases of group A, partly to difficulty in determining the exact nature of the primary affection. Since this discrepancy has little influence on the treatment it is of no great clinical importance.

Etiology. 1. *Anatomical and physiological predisposition* is usually regarded as an important element in the etiology of colic. It is doubtless true that the horse is subject to more dietetic irregularities and imperfections than any other animal, but the relative importance of such predisposition is not easily determined. The horse is more sensitive to irritation and responds more quickly to pain than most domestic animals.

The *stomach* of the horse is small when compared with the bulk of food eaten, and the food itself receives very little mastication before it is swallowed. The normal capacity of the stomach is about ten quarts. In one hour a horse may easily eat five quarts of oats and five pounds of hay, to which must be added five to ten quarts of glandular salivary secretions and perhaps as much more water. Usually the food enters the left sac of the stomach where the salivary digestion continues and gradually passes into the pyloric end where it receives peptic digestion. With medium grade distention the pylorus relaxes and the food passes into the duodenum. Food and water may also pass directly into the duodenum under conditions which favor fermentation and indigestion. Interference with the normal evacuation of the stomach predisposes to grave results, since overdistention appears not to stimulate the vomiting centers of the horse as in most animals. Conditions, then, which favor un-

physiological distention and relaxation of the stomach wall are especially dangerous.

The *small intestines* are suspended in a long mesentery, and volvulus occurs in about 2 per cent of clinical cases. The duodenum is restricted in its movements by a short mesentery and through its relation to the fixed mesenteric attachment. Food accumulations on the right side at the point of curvature toward the left are not rare. In the *ileum* accumulations are common directly in front of the ileo-caecal opening. The terminal end of the ileum is restricted in freedom of movement through its short mesentery and its fixed attachment to the caecum, while the ileo-caecal opening is small and directed towards a mass of relatively dry and bulky residue. Froehner and Behren maintain that the most important predisposing factor is the extraordinary amount of continuous work required of the ileum in forcing the residue through an opening smaller yet than its own diameter into the dry caecal contents. They also attribute food accumulations to cicatricial stenoses of the ileum, and mention its strong muscular development and consequent mechanical injury through contraction on sharp roughage as a predisposing cause. Reference is made by both authors and by the Berlin Pathological Institute to the frequency of cicatricial stenosis in the ileum.

In the *large intestine* the seats of predilection for impaction are in the caecum, the left ventral part of the colon including the pelvic flexure, and the right dorsal part of the colon (stomach-like dilatation). In each of these three locations a bulky dry residue must be carried upward in a sac-like dilatation and then forced through a physiological constriction in the alimentary canal. In addition the right dorsal part is firmly attached to the abdominal wall and pancreas at its base, while the exit into the small colon is not only small but bent at a right angle. The colon is largely unsupported and torsion occurs in about 2 per cent of clinical cases. *Thrombosis and embolism* of the anterior mesenteric artery and its branches are peculiar to the horse.

2. *Dietetic errors* are the most important primary causes of indigestion. Usually the cause is to be found in the poor quality of the food and the following arrangement from Hutyra and Marek indicates the principal defects:

*Indigestible* (corn, rye, coarse straw).

*Swells rapidly* (new clover, peas and beans).

*Cohesive* (chopped hay and straw with corn or barley meal or bran).

*Ferments* (young wilted clover or alfalfa, beets and potatoes, heating grass or new hay, green roughage of any kind when followed by an abundant drink).

*Damaged* (mouldy grain or roughage).

*Frozen or hot feed.*

*Overfeeding* of a good quality of grain or roughage is not a common cause of colic. *Irregular* feeding, however, or rapid hard work immediately after a heavy feed, frequently seen in hack and livery horses, is an important etiological factor. Dieteitic errors may induce catarrhal conditions that lead to intestinal spasms, to atony (overdistentions), or impactions with the corresponding danger of a subsequent rupture or displacement.

3. *Defective reflexes* (cold, heat, fatigue, hunger).

Normal peristalsis is maintained reflexly through mechanical irritation of the mucous membranes by the food, the activity in general being in proportion to the roughness of the fodder, though too much roughage may induce atony (straw). Physiologically there is no peristalsis in an empty intestine, while pathological suspension occurs when the muscular contractions are weakened or suspended by overdistention with gas or when the volume or weight of the food is too great.

*Cold* promotes peristalsis reflexly through stimulation of the skin and the atmosphere thus maintains a certain tonus of the body during life. In the horse colic curves often correspond to atmospheric extremes. The reflex action of cold is to induce vasoconstriction and increase the tone of the voluntary and involuntary muscles. When increased tonus (tension) is abnormally prolonged fatigue occurs so that a return to normal atmospheric environment is followed by a general relaxation, which is supposed to favor food stasis and accumulation. This usually occurs after the animal is brought to the stable and the charts of Wall prepared at Stockholm show an elevation of the colic curve on the days following wind and rain. Relaxation is thought to be due to resorption of the products of fatigue (autointoxication). *Hunger* seems to cause relaxation through deficient cellular nutrition. Overwork with subsequent *fatigue* has a similar effect on the reflexes and it is probable that diminished heat radiation on *hot humid days* with few currents of air is responsible for the intestinal hyperemia and colic so common in summer (retention of the products of oxidation). *High temperatures* diminish the stimulation of the skin and reflexly induce vasodilatation and diminished peristalsis with a corresponding tendency to food accumulations and impactions. Klimmer draws attention to the inappetence of intestinal congestion, and the frequency of cerebrospinal congestion (heat stroke) in hot humid atmospheres.

The extent to which reflex overexcitation or overdepression is a predisposing cause of functional indigestion is not readily de-

termined. Contributors to general medicine seem inclined to regard them as important factors and their conclusions are strongly supported by clinical experience. The general practitioner soon learns to recognize colic weather even in the absence of a theoretical knowledge of atmospheric relations. It remains for future investigations to determine to what extent reflex stimuli affect intestinal secretions and sensations as well as motion.

4. *Displacements and obstructions* are nearly all secondary mechanical complications and careful autopsies show that in many cases of volvulus there is an impaction posterior to the displacement. In eighteen cases of volvulus examined by Behren he failed to find food accumulations in only three. In a series of 162 displacements food obstructions or impactions were present in 81 per cent (Pilwat, Behren). Unequal filling and weight of intestinal loops, excessive peristalsis, rolling from pain, and anatomical relations previously mentioned are generally considered to be prominent causes. Intestinal *obstructions* in the horse are usually due to calculi, less frequently to fecal balls, parasites or foreign bodies. Intestinal *stenosis* or stricture is said by most observers to be uncommon although the Berlin Pathological Institute reports its very frequent occurrence.

Pathogenesis. *Gaseous formation in indigestion.* Normally the gaseous material in the intestine is absorbed by the blood (oxygen, carbon dioxid) or is passed off. Catarrhal or other conditions that cause intestinal hyperemia restrict resorption and promote tympany. Bacterial fermentation with the formation of marsh gas, carbon dioxid, and fatty acids takes place promptly in all forms of indigestion, suppressed peristalsis and atonic conditions being ideal for the increase of bacteria, toxic products and gases. Increased distention from the formation of gas finally leads to atony or complete paralysis of the intestine, and in many cases to intense and continuous pain.

*Pain* (colic) is due to tonic contractions of the intestinal musculature. It is doubtful if neuralgia of the intestinal nerves (enteralgia) ever occurs, while increased peristalsis is not painful. The pathogenesis or reflex effect of pain is as follows: the force of the heart is at first increased from stimulation of the vagus, followed by weakness due to paralysis. The respiration is at first stimulated, but finally the animal becomes dyspneic from a subsequent paralysis. Vasomotor constriction is followed by dilatation. The voluntary and involuntary muscles undergo clonic contractions with evacuation of feces, gas and urine. Perspiration is increased from stimulation of the sweat centers. The sensorium is deranged and the animal appears to be blind and without feeling.

There are two opposing reflexes in prolonged severe pain; paralysis due to paralysis of the heart and vasoconstrictors, and general excitement. With intense pain the paralysis may be so marked that the animal is unable to stand. With relaxation of the pain a period of soper follows, the animal is exhausted. The reflexes may be slight or intense according to the degree of pain.

*Asphyxia.* Fermentation with the formation of gas may increase the abdominal pressure until dyspnea is marked and the blood overladen with carbon dioxid. With a marked decrease of the oxygen in the blood, reflex excitation is followed by depression and finally by paralysis of the circulatory and respiratory centers. The reflexes of asphyxia and pain are practically identical, but the treatment is different.

*Rupture* is liable to occur when the animal throws itself; death from putrid intoxication usually following within twenty-four hours (Wall). As a rule the animal lives only a few minutes after rupture of the stomach.

*Displacements* cause intense pain from pressure, and a marked venous congestion that soon leads to rapid transudation which may even cause death from loss of blood.

*Intoxication.* The general effect of resorption is to cause a putrid intoxication. The toxins are resorbed by the lymph and blood and pass to the liver. The hemoglobin of the red blood corpuscles passes freely into the plasma (varnish color), while changes in the cells of the vessel walls cause petechiae and ecchymoses in the serous membranes. Degeneration of the muscle of the intestine predisposes to rupture; irritation of the heat centers causes elevation of the temperature and an increase in the frequency of the pulse and respiration. Finally the temperature becomes subnormal, paralysis of the circulatory and respiratory centers develops and death ensues in one to two days.

When the resorption is insufficient to cause death the local reaction is more pronounced and local inflammation may develop. In the presence of extensive passive hyperemia of the intestines gangrene is more liable to develop than inflammation.

Symptoms. In all forms of colic a consideration of the condition of the pulse, the peristalsis, the temperature, and the conjunctival mucous membrane is of primary importance in the determination of the gravity of the disease. In some cases a comparison of the general symptoms is our only index to the exact character of the affection, while dexterity and experience in the physical examination of the abdomen, especially by means of rectal examination, is our most reliable method of making an exact clinical diagnosis.

*Catarrhal spasm of the intestine* represents the simplest and mildest form of colic. The pain often develops suddenly, continues from ten to fifteen minutes and then relaxes for a time. The peristalsis is active and the pulse, respiration and temperature are nearly normal. Defecation occurs frequently and diarrhoea may be present. Recovery within a few minutes to five or six hours is the rule unless there should develop a secondary volvulus.

*Acute distentions* are more severe. Primary gastric distentions usually develop soon after eating. The stomach contents may consist of gas, or a uniform mixture of gas and fermenting food, or an impacted mass of dry food (corn meal, fibrous roughage). The pain is intense and continuous and the horse may roll and plunge violently. The pulse is usually 60 or above, the respiration is increased, even dyspneic, and the temperature is normal or slightly elevated at first. The conjunctival mucous membrane is injected, perspiration abundant. One of the most characteristic symptoms is the presence of undulating movements up the jugular groove (eructation) as well as retching and vomiting. The vomited food as expelled from the nose or mouth has a sour penetrating odor. The stomach tube is readily passed and the stomach contents may or may not be discharged through it according to their consistency; usually one notes a sour odor at the end of the tube. The frequency of the eructation also depends on the consistency of the stomach contents. The abdomen is only slightly enlarged, peristalsis is usually suppressed or absent and defecation is suppressed after a short time. Rectal examination may reveal some tympany of the small intestines, especially in the duodenum just posterior to the anterior mesentery (small horse). In cases of marked tympany of the stomach it is said that the blind end of the stomach or the base of the spleen may be palpated in the region of the left kidney or the external angle of the ileum. Mild cases may respond to simple treatment and show only general symptoms of colic, but severe cases must be given prompt relief as fatal complications develop early (rupture of the stomach or diaphragm).

*Intestinal gaseous distention* is characterized by abdominal tympany that develops soon after eating, though horses with rigid abdominal walls may not show marked abdominal enlargement even in severe cases. The intensity of the pain is usually proportional to the amount of fermentation and gas. The pulse is rapid and often weak, the respiration is always dyspneic (asphyxia) and the temperature may be normal or slightly elevated. The mucous membrane shows diffuse redness (paralysis of the circulatory and respiratory centers, decomposition of the blood from putrid intoxication) or venous congestion. Peristalsis is normal at first, afterwards suppressed or one may hear

tinkling sounds. On rectal examination the abdomen is found distended in all its parts so that palpation is impossible. Secondary distention of the stomach is of frequent occurrence.

*Accumulations and impactions* cause diverse symptoms according to the seat in the large or small intestines. Primary food accumulations in the *small intestine* usually develop soon after eating, the symptoms develop quickly and the progress is rapid. The rectal examination is negative or one may palpate a cylindrical swelling about the size of a man's arm directed transversely across the abdominal cavity at about the plane of the anterior border of the left kidney (H. & M.). Anorexia is complete from the beginning. The pulse and respiration gradually increase, peristalsis and defecation are suppressed. Secondary gastric distention is present in about 50 per cent. of cases and secondary rupture of the stomach may occur. Rupture of the intestine itself is not rare. In other cases sepsis and intoxication from resorption of putrefactive gases supervenes with corresponding heart weakness, fever, depression and marked diffuse redness of the conjunctival mucous membrane.

Impactions in the *large intestine* present more definite symptoms with the possible exception of impaction of the right dorsal part of the colon (stomach-like dilatation). In most cases the diagnosis can be made by rectal examination alone. Defecation is partially suppressed for several days and finally becomes complete, mild colic then develops, characterized by rather long intervals of freedom from pain. Finally the colic is more continuous but is rarely intense. The patient frequently assumes an attitude like that of a horse when urinating. The abdomen may be normal in size and like most forms of colic the peristalsis is suppressed. Rectal examination reveals a distended intestine of a semi-solid or firm consistency. The colon may fill the entire left half of the abdomen. The left inferior part is recognized by the presence of sacculations and longitudinal bands, the left upper part is smooth and enlarges as the hand is carried forward. Both are united by the pelvic flexure which may be found in the pelvis. The right dorsal part in front of the caecum is difficult to palpate; it may be reached in small horses. The caecum is easily reached in the upper part of the right flank where it is recognized as a roundish enlargement about the size of a man's head, smooth on the surface and firm in consistency. Occasionally one may be able to palpate the two longitudinal bands. In impaction of the caecum one may find tympany at its base and in the terminal attached portion of the ileum. Impaction of the small colon is easily recognized on rectal examination in the region of the left flank.

*Volvulus* of the small intestines frequently escapes a positive clinical diagnosis. A provisional diagnosis is reached by considering the intensity of certain general symptoms, the findings of a rectal examination, and the duration of the disease. Tympany develops rapidly as the deranged circulation suspends the absorption of gases and fermentation aids in their development. Loops of distended small intestines are found in the posterior part of the abdominal cavity. The pulse is very frequent and weak, finally imperceptible, the heart impulse is increased and the temperature usually elevated. These severe general symptoms develop within one or two hours after the intestine is displaced, while their development in food accumulations and other obstructions takes place more slowly. In seventy-five cases observed by Behren death took place in ten to twelve hours. The cause of death is sepsis and asphyxia.

*Torsion of the colon* induces the same severe and rapidly developing symptoms as volvulus of the small intestine and incarceration. In rectal examination the left half of the colon is found to be very tympanitic so that it often fills the entire left abdominal region. Torsion of the left colon is recognized by the spiral direction of the longitudinal bands. In torsion to the right the spiral has a left anterior direction, in left torsion the spiral has a right anterior direction. According to Behren a certain degree of distention must be present to recognize with accuracy the different parts of the large intestine. In general the course is very rapid, though like volvulus and other displacements it is usually secondary and the intense symptoms are liable to develop only after the animal has been sick for several hours. In 70 cases observed by Behren death took place within 6 to 12 hours.

*Gastric rupture* presents the same severe clinical picture. Pain may suddenly cease but the general attitude; pulse 100 and imperceptible, subnormal temperature, and the intense diffuse redness of the mucous membranes indicate the gravity of the case. On rectal examination one finds no resistance in the upper abdominal region. Death occurs within a few minutes to a few hours. *Rupture of the diaphragm* presents the same series of rapidly developing severe general symptoms. It is characterized by intense dyspnea.

*Incarcerations* within the abdominal cavity seldom present distinct differential symptoms. The general symptoms are those of displacements. In general the tympany is less than in torsion and volvulus. This statement does not apply to strangulated hernias.

*Thrombo-embolic* colic may be diagnosed in small horses by palpation of the anterior mesenteric artery. One may be able to

palpate the thrombus and to recognize the deranged pulsation. Repeated attacks of colic that develop with exercise in horses that receive regular care and proper food is sufficient evidence to arouse suspicion. Rectal examination is usually negative, and tympany is slight or absent. In this affection the general symptoms of colic are somewhat diverse.

*Treatment.* In all colic due to *primary indigestion* the fundamental object is to evacuate the alimentary tract. In those forms that are not too severe or persistent the rapid subcutaneous purgatives (eserin, arecalin, pilocarpine) which act reflexly through the nervous system have proven very satisfactory. Evacuation is prompt and in one or two hours the effect of the drug has passed. Since they are powerful depressants they should be used with caution whenever the general symptoms of colic are severe (weak pulse, depression, suppressed peristalsis, diffuse redness of the conjunctival mucous membranes, tympany and fever). In such cases the effect of one or two doses may be highly satisfactory, but in the absence of relief they should not be continued. In the treatment of food accumulations in the small intestines Behren gives first .75 of a grain of arecalin. If this produces no result he follows it in one-half to one hour with the same amount of eserin. He assumes that the food is softened and loosened by the action of the arecalin on the glands and that the effect of the eserin on the musculature induces peristalsis and promotes evacuation. If the impaction still persists he resorts to aloes.

Agents that act directly on the alimentary system (aloes, oil, salts) are less depressing and their effect is more certain and prolonged, though not so prompt. Peristalsis may be promoted reflexly by cutaneous irritants over the abdominal wall or by cool rectal injections. Abundant rectal injections of slightly saline warm water introduced slowly, or slow walking exercise, assist in the relief of impactions of the colon.

*The stomach tube* is perhaps our most valuable recent addition to the therapeutics of colic. It affords relief in most cases of acute primary distension of the stomach, or distensions secondary to intestinal indigestion. It seems to have been first adopted for general use in the clinic at Budapest where for several years it has been used exclusively in the treatment of primary acute gastric distensions. Marek reports recovery in 81 out of 85 cases in 1906. The Marek tube is somewhat larger than the one ordinarily used in America. Behren speaks favorably of its use in about 250 cases in the Berlin clinic. The tube is easily passed through the mouth, after first inserting a stilet to within six or ten inches of the end, and when the stomach is tympanitic relief is usually prompt. Impaction of food requires injection of warm water followed by siphonage, this may have to be re-

peated several times to loosen an impacted mass, while in secondary tympany it may be necessary to pass the tube at frequent intervals.

*Fermentation* with the formation of poisonous gases and toxins may be restricted with creolin given in half ounce or ounce doses every few hours. Some prefer lactic acid given in doses of 2 to 3 drams. Whenever intestinal tympany causes discomfort it should be relieved with the trocar. Usually this is accomplished through trocarization of the caecum in the right flank, in some cases however it may be necessary to trocarize both flanks in order to release the gas. With a small trocar and surgical cleanliness the operation is safe. The writer has always passed the trocar at the point where distention appeared to be most marked.

*Pain* when prolonged and intense should be controlled with narcotics. Chloral per os or rectum and fluid extract of Cannabis Indica injected into the jugular vein are widely used. Morphine is still employed though many clinicians are positive in their assertions that it is uncertain in the relief of pain in the horse, that it is directly opposed to the evacuations of the bowels, and that in some cases it induces overexcitation. During acute attacks of pain the animal may be walked slowly to prevent rolling or throwing. Hot applications, or counterirritants like mustard or ammonia liniment, tend to relieve pain, promote peristalsis, and overcome the effects of an early intoxication (drowsiness).

*Displacements* within the abdomen rarely respond to treatment. Torsion of the left colon has been treated with varying success by different clinicians. At present rotation of the animal in the direction of the torsion, as in torsion of the uterus, is receiving some attention. Forsell reports 17 recoveries out of 18 torsions of the colon. Hutyra and Marek question the accuracy of his diagnoses and report uniform failure of treatment in their own cases. Behren reports success in only one of four attempts and he also questions the accuracy of the diagnoses of some writers as revealed by their clinical descriptions. Since torsion of the colon occurs in only one to two per cent. of clinical cases of colic, reports of its frequent successful treatment are subject to critical examination.

Horses suffering from colic should be kept in a box stall with plenty of straw, the back and abdomen should be covered with a blanket and food and water withheld.

In the preparation of this paper the following writers have been freely quoted.

Friedberger und Froehner.—Spezielle Pathologie und Therapie der Haustiere.

Hutyra und Marek.—Spezielle Pathologie und Therapie der Haustiere.

Professor James Law.—Veterinary Medicine.

Sven Wall.—Die Kolik des Pferdes.

Doctor Behren.—Die Kolik des Pferdes. *Monatshefte f. praktische Tierheilkunde*, XXII Band, 3 Heft.

Osler's Modern Medicine.

# Dairy Cattle

PROFESSOR H. H. KILDEE, AMES, IOWA.

I am a little afraid I cannot tell you a great deal that will be new. As you will remember, Iowa leads all the states in the valuation of horses. The veterinarians have always had more to do with horses than cattle, because when cattle were cheaper it was seldom that a farmer called the veterinarian to treat cattle. Iowa now stands third among the states of the Union from the standpoint of number and valuation of dairy cattle. During the past few years Iowa has been going steadily forward in the number and valuation of dairy cattle, and during the same period the valuation of horses has declined. During the past five years in this section of the United States the valuation of horses has declined $15 a head; they now are valued at $105 instead of $120. We find about the opposite condition as regards dairy cattle.

There are many reasons why dairy cattle are increasing in numbers and value in this section of the country. In the first place we realize the law of supply and demand. With the increasing attention paid to intensive agriculture, with the increasing population of the cities, there is of course an increasing demand for dairy products and therefore an increasing demand for better cattle. Where they are farming most intensively the dairy cattle furnish the largest per cent. of the income of the people. In Holland, where the land rents for $30 to $40 per acre, dairying is the chief industry; on the Jersey and Guernsey Islands where land rents for $50 to $60 per acre, dairying is the principal industry. A recent writer has said that the countries that are not involved in war are the countries where dairying is the principal industry.

I wish to show a few lantern slides, showing some of the prize-winners in the leading dairy herds. I realize that not all farmers can have pure bred stock. The time will never come when it will be possible for every farmer to have high-priced cattle. But the highest praise should be given to the farmers in this state for increasing the proficiency of their herds by bringing in some pure bred stock and grading up their herds. It would also pay them greatly to practice better methods in the care and management and thus increase the valuation of their herds. We have cases in our test association work, where the farmers have increased the production of their cows 200 per cent. in three or four years, simply through better care in feeding and management and weeding out some of the cows that have been kept at a loss. In one of the herds we found the first year the

farmer had been keeping one-half of his cows at a loss. At the end of the year instead of having a little profit from each cow he had really been giving from $10 to $20 for the privilege of milking them three hundred and sixty-five days in a year. Of course that does not pay, so from the standpoint of increase in production and profit there is much that can be done without a great deal of outlay in the way of expense. We realize that from the standpoint of comparing dairy cattle with other live-stock, the dairy cow is the most economical producer the farmer can have. We are all interested in economical production because we hear so much about it in all industries. It seems to be the slogan of the present generation. But you compare the dairy cow with the hog, and the mutton sheep, and we find that the dairy cow will produce six times as much table food as will the hog and the mutton sheep from 100 pounds of digestible nutrients. If you consider the ratio of six to one you will realize the worth of the dairy cow in producing food, and producing it more economically, and when we produce it more economically the farmers are making a greater profit from their industry instead of working at a loss.

In one of the test associations last year one of the testers happened to be a Hollander, and when he found that one of the farmers was feeding his cows the old way—ear corn, corn stover, and a little timothy hay—this boy approached the farmer and asked him if he would be willing to let him recommend a ration and let the farmer feed it one month, and see if the results would not be better than what he had been getting. The farmer was willing, and so during the month they fed the cows on the new ration, and they found the profit increased from $2.47 to $40.40 for the ten cows—an increase of $38 in one month, due to the fact that they were fed a mixed feed, and according to production; not feeding all cows alike, but in accordance with production.

In the lantern slides which we are showing I wish to represent the different dairy breeds; also to show some of the points which are emphasized by the people who are breeding pure bred dairy stock. Here we have the world's record Jersey cow. I realize that few people can keep cows in such condition as to make a world record. This cow produced 999 pounds of butter fat in one year. In all great record dairy cows you will note a vast similarity of form, regardless of breed. If you will keep this type in mind in Jerseys, Ayrshires, Holsteins or Guernseys, you will find they are similar in the points emphasized by the judge of the show.

In this case we have a large cow which was shown at the National Dairy Show. She was placed out of the money because she was heavy about the head and neck. These are the

fancy points which are emphasized by judges, and that is one reason why the Jersey cow has lost some of her popularity with farmers of the United States. We know they produce butter fat in quantity and very economically, but we realize that by emphasizing the extreme refinement it was done at the expense of constitution and capacity for production, and this lessened their popularity with the farmer rather than increased it.

A couple of years ago when a man from the college started the test associations, he made it a point to go around to the farmers who had herds and ask them to pick out the cow they considered the most profitable. He found in nearly every case they picked out cows which later proved to be among the less profitable animals.

In this slide we have a prize-winning Jersey which shows just the opposite in regard to refinement from the one we have just seen. You see the extreme refinement of shoulder and withers, an animal rather delicate in the chest, an animal which would not be adapted to stand up under farm conditions. If she was put on the average farm she would produce much more than the average cow, but she is too delicate and small.

Here we have a cow that shows extreme depth of body and capacity for handling the cheap feed upon a farm, and of course that is a point the farmers must emphasize, because the rougher feeds, such as alfalfa and clover hay, and silage, are the most economical.

Here is an animal that rather tends to the extreme scale, but yet shows strength of constitution with fair capacity, and a large, well-shaped udder, which is of course desirable. We find in this animal more refinement than the first one and less than the second. This cow was a prize winner in Chicago a couple of years ago and has a very good record.

The slide shows the desirable rear attachment. In quite a number of dairy cows there is trouble because of the fact that the rear attachment is so narrow that the udder is shoved forward between the legs. This shows a large rear attachment, which of course is desirable.

This shows a cow with a good record, but not a very good form. A rump, sloping and tilting udder nearly parallel between the top of the rump and the sole of the udder.

This is a Jersey bull, with a large number of daughters of unusual merit. This animal was not seen in many shows, because they emphasize extreme refinement; but the records of his daughters where they have used the milk scale and the Babcock test proves him to be the greatest Jersey bull in the country. At Hood Farm they are now selling his sons and daughters from $500 to $2,000 apiece, largely because of the records which his

daughters have made. To some people these prices seem rather enlarged, yet it is always a safe investment to buy a good bull.

In this slide we have a bull that sold for $2,000, but he is rather short in the body and does not have the capacity through the chest nor the middle, nor the length that the farmer wishes in cows.

I just show this slide to show the reason why judges in show rings seldom place young heifers as grand champions, and also emphasize the fact that it is mighty hard to go out and buy pure bred heifers and be sure you will get animals that will make the best cows. In this heifer we have a Jersey that was shown in Chicago in 1912 and was made grand champion over all the mature cows of that breed. A great many people rather doubted the wisdom of the award at the time, but the judge felt he was right. A year later it was my fortune to see this heifer out in Washington after she had returned home, and I found her in the back pasture with the culls of the herd. They were ashamed to have her where people would see her because when she matured she did not show the points of an ideal Jersey; she showed very poor conformation, broken in the back and a very poor mammary system. It shows you cannot go out and safely buy young heifers unless you pay a great deal of attention to their dams and get the best animals.

I will now bring on a few Guernseys. In some respects the Guernseys and Jerseys are similar. I think you remember the Guernseys a few years ago when they were called Alderneys. You will see at once the similarity between the two breeds. The Guernseys come from the Island of Guernsey. They are a more vigorous stock, larger than the Jerseys, a larger udder and a rather distinct yellowish colored pigment in skin secretions and also in the milk secretions. The Guernsey milk is noted for its yellow color among housewives—they usually associate it with fat and when the milkman furnishes Guernsey milk they think it is richer than Jersey milk.

Here we have the Guernsey grand champion of 1912. One of his daughters was the first to produce over 700 pounds of butter fat as a two-year old. He shows the Guernsey type in head and chest.

Here we have a cow owned by Mr. Marsh of Waterloo, the grand champion in Chicago two years ago and second last year. She has produced over 600 pounds of butter fat as a two-year old, and over 11,000 pounds of milk. She is an animal that shows great strength and exceptional capacity and also shows considerable quality, and has left quite a number of good descendants, although she died in Chicago when quarantined with foot and mouth disease.

Here we have a cow that as an 11-year old was made grand champion over bigger cows, a cow very much plainer than the Jerseys, but she shows the same outlines and upon a farm produces a larger quantity of milk.

I may say that Guernseys and Holsteins are the most popular among the dairy breeds in this state, and at the present time Guernseys will bring $200 or $400 apiece at six or seven months old. That shows the demand here. The people here sell them to the west, and the people in the west sell them to New Zealanders, South America, etc. The Holsteins differ from the Jerseys and Guernseys in many respects. This cow was shown for a number of years and was grand champion. She has a very well-shaped head and is representative of the Holstein breed.

This cow produced 134 pounds of milk in twenty-four hours. 920 pounds of milk in seven days, and over 27,000 pounds of milk in a year. One of her stable mates I saw last year in California with a record of over 30,000 pounds of milk—the world's record. It certainly seems extraordinary to think of a cow producing in one year over 15 tons of milk, but the stable mate of this cow made that record last year, and there were inspectors there to see that the weights were properly taken.

Here we have an animal that was grand champion in Chicago two years ago; in fact, he has had first place wherever shown: but just to bring out the point of importance of breed, this bull was sold for beef in the St. Paul market. The owner sold him after one grand champion simply because his breeding was such that he did not wish to continue that breed. He was very plainly bred—none of his dams had made a record, and therefore, the owner considered it would be doing his herd an injustice to continue his use.

Dairymen count 60% on pedigree and 40% for individuality in picking out dairy sires, and the other day in judging over at B..... I ran across an unfortunate dairyman who had bought a bull in Wisconsin and paid $700 or $800 for him, but I did not give him first place. I told this man that he held the pedigree so close to his face that he could not see the individual he had bought. We must consider the character of the individual as well as the pedigree if dairy breeders are to prosper. We have numerous instances where individuals in herds have made good records, but yet the herd has gone down in the estimation of other breeders because they did not breed true to type but made records with rather common individuals and the herd has soon gone down and they have lost money because their animals would not sell for as much as they otherwise would have.

Here we have a breed that is not especially well-known in this state. There are not many herds, although I think there

will be more. This breed is very common through the New England states, there are a great many in New York and Canada, and a few herds in the middle west, but not a great many. In this Ayrshire breed we have the upturned horn, the long face and the white and brown markings as characteristics. This breed is noted because of their rustling ability and also because of economical production; a rather beefy, strong conformation, rather a dual purpose type if there is such a thing, and yet a breed which is not especially popular, largely because importers into this country have brought in the show type rather than the heavy producing type.

In this cow, Kilford Belle III, we have a grand champion dairy cow over the champions of all dairy breeds at Chicago the last two years, and won the silver cup. She shows the straight lines that the Ayrshires are noted for. Some are more compact between the ribs and along the spine, and some are beefier in the thigh, some are heavier in the udder and with a more level udder along the sole than in other dairy breeds, and with that level along the sole we have two disadvantages—one that it is lower, and that it has short teats which are troublesome to milk.

Here are Ayrshire cows shown at the National Dairy Show. They exhibit the universal characteristics of a strong back and well-shaped udders, animals that are rather short in body but strongly made.

A grand champion of a dairy herd of Ayrshires bringing out some of the characteristics of this breed as compared with Holsteins, Jerseys and Guernseys. Rather beefy throughout but a type which has been sought for by most of the breeders. His daughters are not making very good records, they are rather beefy, and for that reason are not as popular.

Here is an Ayrshire bull of another type who was grand champion at Chicago four years ago and has been grand champion wherever shown.

This bull, Peter Pan, was grand champion at Chicago and Canada. He shows a good deal of refinement.

Now come the Brown Swiss. We have two or three herds in this state, but it is a breed that will never become as popular as the Holsteins, Jerseys and Guernseys or probably the Ayrshires, in the United States. They are very coarse in bone and limb, but said to be very hardy, and while we find Brown Swiss animals that will make large records, they are not as universally good producers as other breeds.

Here we have a representative of a breed that is bred for beautiful color patterns rather than for economical milk and fat production. We find in judging this breed in the show ring

that the judge has usually a rather easy time. He simply looks at the width of the belt, tells whether it runs in a straight line over the hips—it does not make much difference whether there is anything beneath the belt or not. We find quite a lot of this breed in New Jersey and in the Southwest, especially on the farms of rich people who wish something to look nice in the landscape and do not care much about production.

I simply wish to mention in conclusion that we do not wish to advocate that all the farmers in the state try to have cattle of the standards which I have shown in these slides. I realize that the time will never come when all the farmers can afford to maintain pure bred herds. The grade dairy cows will produce just as much, and just as economically as the pure bred animal, especially if you have good dairy blood in their veins. But the man who can afford to do so, to invest the capital, can make mighty good interest on his money by raising some pure bred animals and selling surplus stock to neighboring farmers and breeders.

I might cite a case of a young farmer in New York state. He had started in a few years prior to my visit, started on borrowed capital. His father was very much opposed to this young man investing his money this way and would not loan him any, so the fellow went to one of the bankers in Syracuse and borrowed enough money to buy two pure bred cows. He bought them for $150 apiece, took them to his farm, and one raised a heifer calf and the other a bull. At the time I visited the farm Mr. Francis Jones had just made a world's record with the heifer and sold her for $10,000; the bull calf out of the other cow he sold for $6,000, and I had a letter from him this spring saying he had bought his father out, that he had paved the road to town, and that the last three sales of cattle he had averaged $3,000. We find this same thing other places, and we find many farmers in this state are going about it wisely. Instead of buying a lot of cows that a neighboring dairyman is anxious to get rid of, they buy pure bred sires and use the best grade cows, weeding out the inferior cows, and they soon build up a herd that will produce largely and economically. One of the dairymen over at Cedar Falls figured that he increased his profit 269% simply by weeding out the poor cows and substituting grade heifers he had raised upon the farm. We find that much can be done by people who wish to promote the livestock industry in their section by advocating the use of pure bred sires and culling out the inferior animals.

It is not only a matter of better cows, but also of better care, in feeding and management, to get the best results from the dairy cattle of this state, and many cows on the farms have increased 50% and 60% and sometimes 90% in production after

they are properly fed, and if we stop to realize what it would mean if we could increase the average production 50 pounds of butter fat a year—it would mean over eighteen million dollars to our farmers.

At the present time there is a great demand through the west and southwest for grade dairy cattle from this section. Some months during the past year I received letters asking for as many as six or seven carloads of grade and pure bred dairy cattle, and when people are willing to pay our farmers from $100 to $135 a head for grade dairy cattle, there is much more money in it for the farmer than the way he has been raising beef and dual purpose cattle. The dual purpose cattle which have been raised in this state are really semi-purpose cattle; they do not serve more than half of one purpose, let alone two. In order to produce milk and butter fat you must have good breeding, and in the last analysis that is the test of the best cow, regardless of color, shape or horn. What the farmers want are not show animals, but animals to depend upon on the farm.

# Some Points on the Surgical Anatomy of the Anterior Part of the Head, Including a Preliminary Study of the Teeth and Sinues of the Horse

H. S. MURPHEY, AMES, IOWA.

Consideration of this subject naturally calls for a study and discussion of the bones of the head. The frontal bone shows the supra orbital process, and its two plates are separated to form part of the frontal sinus. It articulates principally with the lacrimal, nasal, superior turbinate and ethmoid. The malar forms part of the orbital margin and facial crest. The lacrimal bone contains the bony naso—lacrimal canal which is the lateral boundary of the fronto-maxillary opening. This bone also aids in forming the lateral wall of both the frontal and maxillary sinuses. The nasal bone forms the roof of the anterior part of frontal sinus as well as the dorsal wall of the nasal cavity; it gives attachment to the superior turbinate. The palatine bone bounds the posterior nares, anteriorly and laterally. It therefore forms the posterior part of hard palate, and is between the oral and nasal cavities. It also, with the maxilla, forms the palatine canal which lodges the palatine artery, as well as a ventral groove or trough which carries the palatine vein to the pterygo-palatine fossa. The maxilla presents the palatine process and a body which shows on its lateral surface posteriorly the facial crest the anterior end of which is above the third or fourth cheek tooth (Sisson[1]), except in colts under one year of age it is between the second and third cheek teeth.

In the adult the infra orbital foramen is one-half inch in front of the anterior end of facial crest and two inches above the same point. Anterior to the facial crest the bone shows concave above, convex below, in the colt. As the teeth are pushed downward into the oral cavity to compensate wear, the alveoli close and the lateral plate of this bone recedes medially so that the surface becomes slightly convex posteriorly, straight in front, or even concave above the first cheek tooth. The medial or nasal surface exclusive of the palatine process is concave in the new born; concave above and below, convex in the middle at the inferior turbinal crest in the two to six year old, on account of the teeth, then the medial plate moves toward the lateral plate to close the receding alveoli as the animal grows older.

The ventral border shows the interdental space, the alveoli (containing the superior cheek teeth), and the alveolar tuberosity, which furnishes origin in part to the depressor labii inferioris and the buccinator. Medial to the alveolar border is found the palatine process which forms the principal part of the hard palate. The most important point here is the palatine groove which is parallel to the cheek teeth, and one-half inch medial to the lingual surface of the same. It lodges the palatine artery. (Fig. 15.)

One of the most remarkable changes taking place in this bone is the development of the infra orbital (superior dental) canal. In the new born foal it is merely an arch placed over the alveolar plate of the cheek teeth. It is still this way at three months. We use the term alveolar plate to indicate only the plate of bone dorsal to the root of the teeth and use the term inter alveolar plate to indicate the transverse septum between two alveoli; it should be noted that dorsally this may be divided into two plates of compact bone separated by a layer of spongy bone of varying thickness. At one year there is a considerable increase in the thickness dorso-ventrally measured from the lower margin of the infra orbital canal to the grinding surface of the second cheek tooth. It is 7 cm. in a three months old colt, while it is 8.5 cm. in a yearling. In the latter case the anterior part of canal is lifted above the alveolar plate, probably due to a recession of the latter. From one to four years there is not much change on account of rapid growth of the permanent teeth. From four to five years on, the canal becomes independent due to the receding teeth. This is especially noticeable over the third and fourth (and sometimes the fifth) cheek teeth in the anterior compartment of the maxillary sinus, which is partially divided into an internal (turbinal) and external (maxillary) portion by this canal and the bony plate below the canal. This plate fuses below with the medial or nasal plate and internal portion of the alveolar plate, the latter aiding in forming the floor of the sinus. It is important to keep this canal and plate in mind so that drainage laterally can be understood. The infra orbital canal can be outlined topographically in all ages if we remember that it begins at the maxillary foramen, in the maxillary hiatus, which lies directly medial to the middle of the lower border of the orbital margin. The distance is two to three inches depending upon age and size of head. Now we shall draw a line to the infra orbital foramen. Viewed from the side the canal will be a little higher in the middle, since it is slightly convex dorsally in its length. (Ca. .5 cm. in the adult. We have one specimen that is straight.) Up to one year, it is

usually straight. The convexity is probably due to a pushing up of the alveolar plate above the developing teeth. It might be noted that the facial crest with the zygomatic arch and this imaginary line form a sagittal V opening anteriorly. Again it is in a sagittal plane approximately 5 cm. lateral to median plane. (Fig. 1 and 2.) This may be determined by drawing an imaginary sagittal plane backward from the infra orbital foramen, parallel to the median plane. It would be just medial to the coronoid process of the mandible. The infra orbital canal gives off near the infra orbital foramen a small canal (canalis alveolaris incisivus) which carries the nerves and vessels to the premolars, canines and incisors. (Fig. 36.) It lies just above the roots of the premolars and extends forward into the premaxilla. It might be noted that the vessels supplying the incisors receive a number of anastomotic branches especially from the palato-labial artery.

The premaxilla forms the floor of the anterior bony nares. It carries the incisor teeth and aids in forming the bony hard palate. The turbinates have four striking features: 1. They are covered by a very vascular mucous membrane. 2. The anterior part is cartilaginous. 3. The central part is the *only scroll-like portion.* 4. They form part of the paranasal sinuses (Fig. 1 and 108.) The dorsal one forms the medial and ventral boundary of the anterior part of the frontal sinus while the ventral one forms the dorsal, medial and ventral boundary of the internal (turbinal) part of the anterior compartment of the maxillary sinus.

The septal cartilage forms the principal part of the skeletal nasal septum. It is thick and rounded below where it rests in the groove of the vomer and premaxilla. This is especially marked anteriorly, where we also find it extending laterally, above, to form the parietal cartilages. Approximately in the center, it is thickened but thin above and below, while posteriorly it is thin above and thick below. (Fig. 18, 107 and 108.) The mucous membrane is very vascular, especially near the middle, dorso-ventrally. The two turbinates project medially into the nasal cavity and since they do not reach the septum we recognize four meati. Note that on this sagittal section that the ventral meatus directly connects the anterior and posterior nares, furnishing a direct passage for the air in respiration. Note also the small space here, and the vascularity of the mucous membrane bounding it in this cross section. The middle or sinus meatus furnishes the only outlet of the sinuses.

(Oral cavity demonstration, on cross, sagittal and horizontal sections with dissected specimens.)

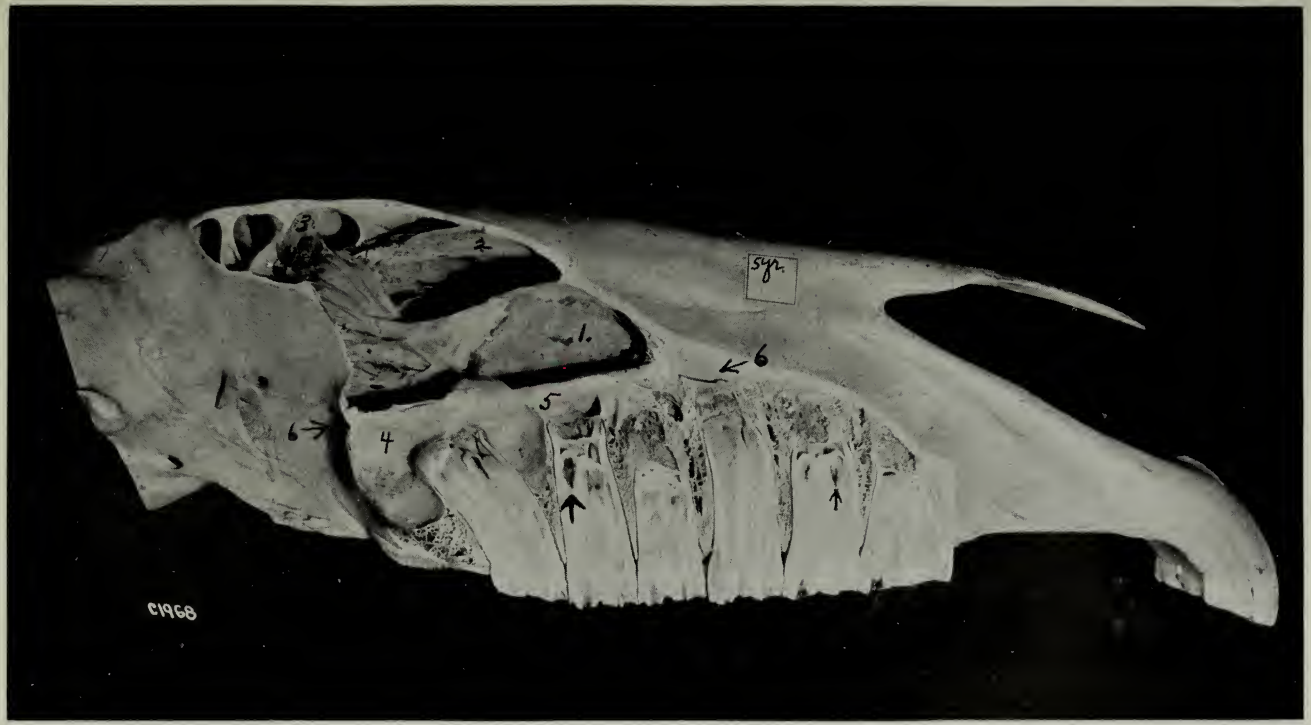


Fig. 1—Sagittal section of five-year old head to show teeth and sinuses. Notice direction of teeth and interalveolar septa.

1. Turbinal (internal) portion of anterior compartment of maxillary sinus.
2. Turbinal (anterior) portion of frontal sinus.
3. Frontal sinus proper (posterior part).
4. Posterior compartment of maxillary sinus.
5. Outer or maxillary portion of anterior compartment of maxillary sinus.
6. Infra orbital canal.

Arrows on second and fifth cheek teeth indicate cement defect at bottom of infundibuli.

Fig. 2—Sagittal section of five-year old skull, viewed from above showing direction and position of infraorbital canal. Compare Fig. 1.

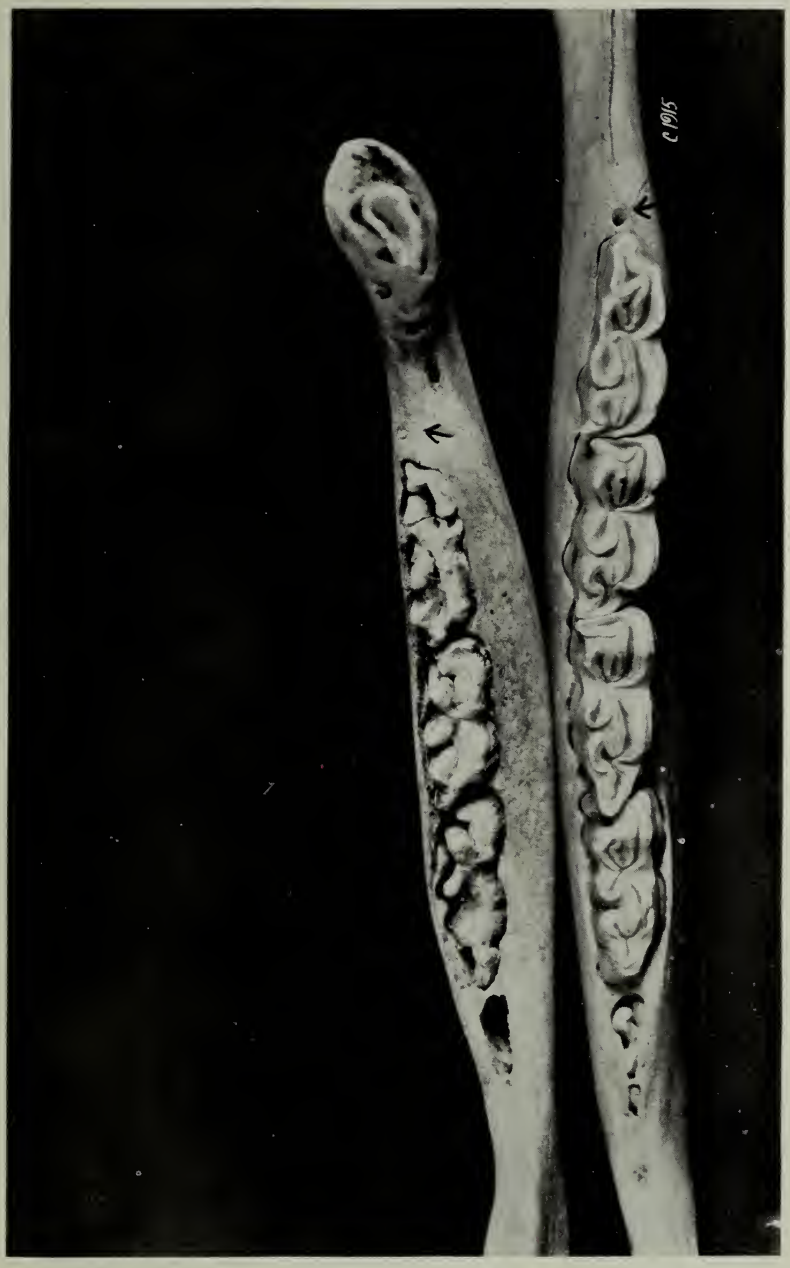

Fig. 3—Mandibulae, to show first premolar (wolf tooth) of a fetal jaw insitu, and of a yearling showing a well developed alveolus (tooth lost).

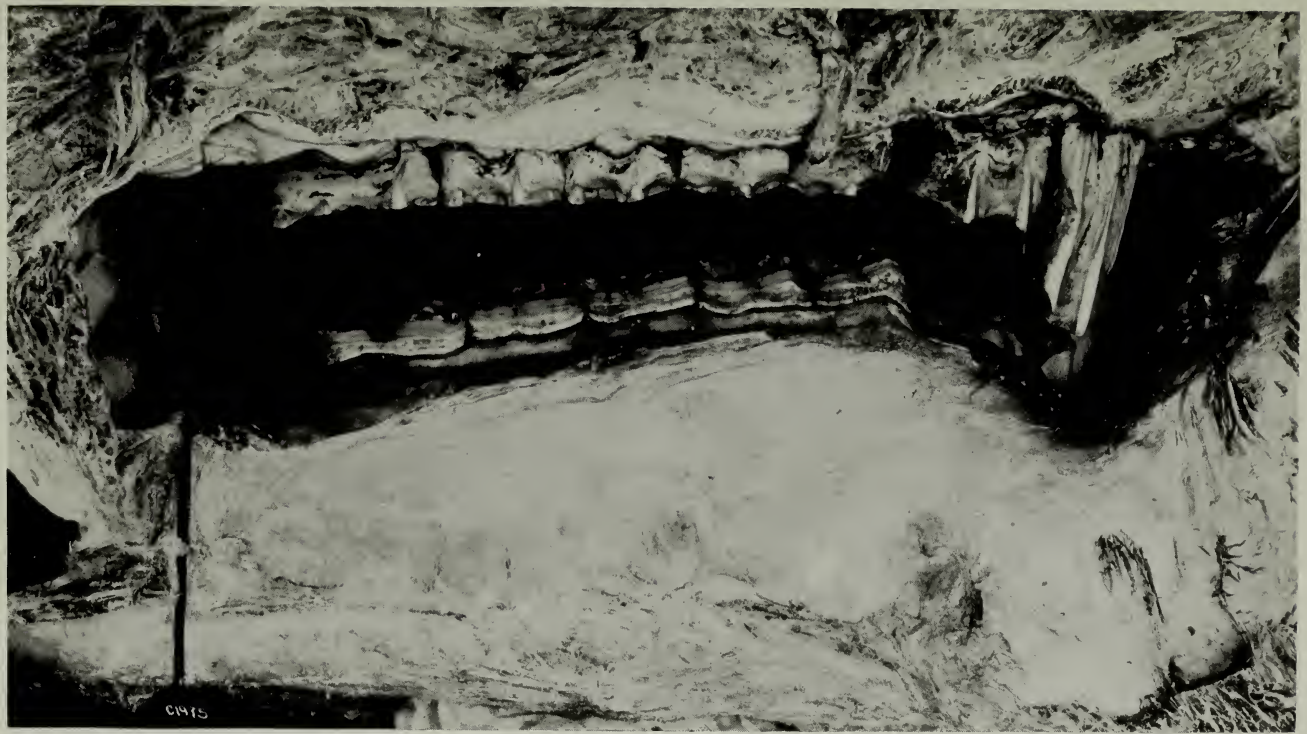

Fig. 4—Lateral view showing long supernumerary third molar (?) above, also effect on mandible.

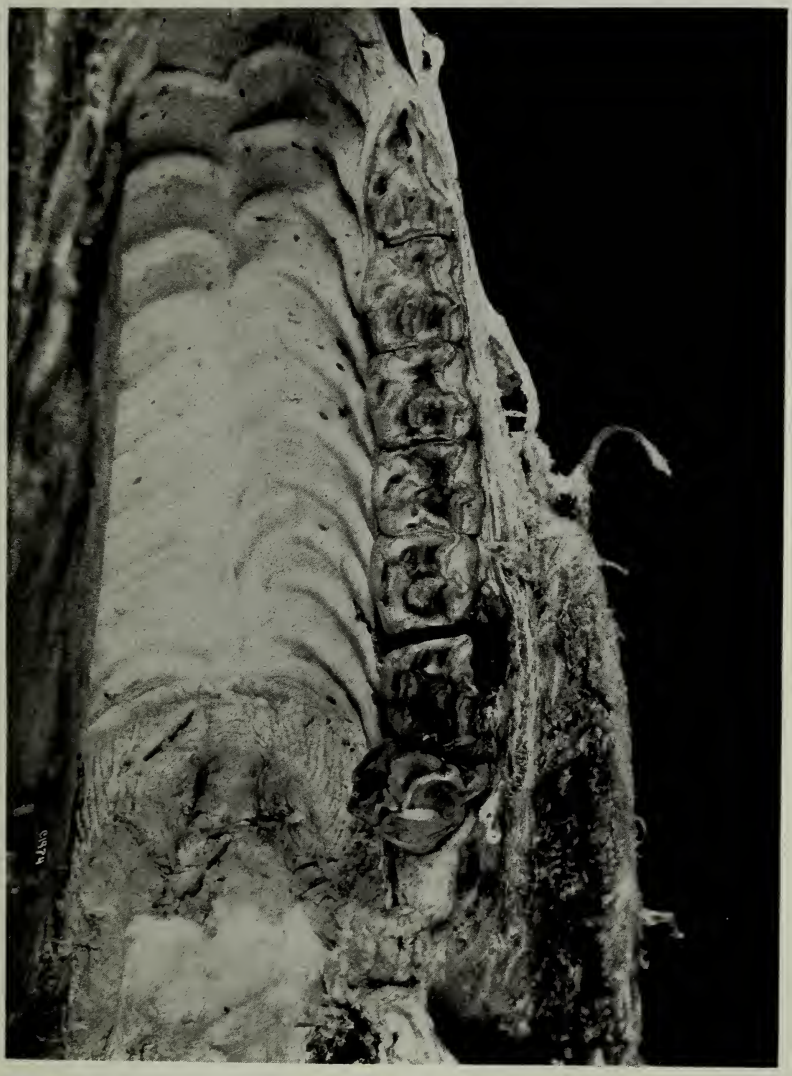

Fig. 5—Oral aspect of Fig. 4 showing supernumerary third molar (?) above.

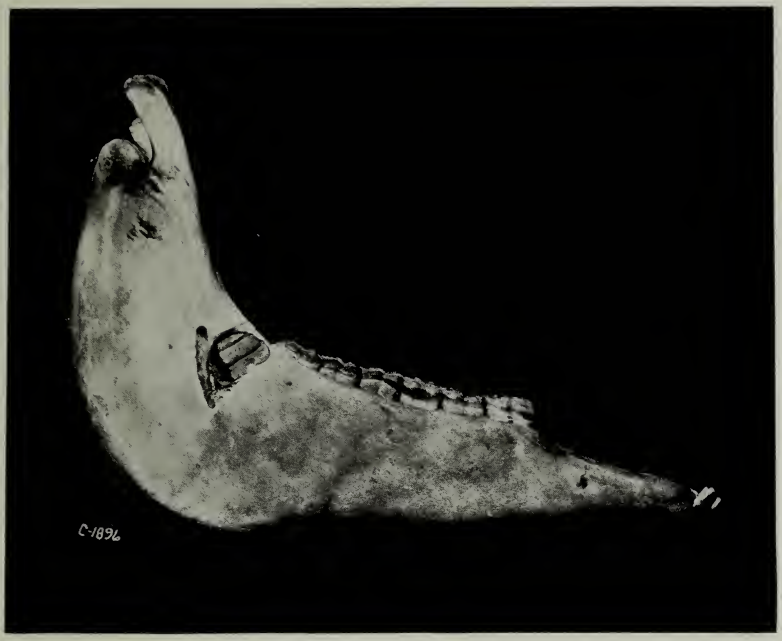


Fig. 6—Lateral view No. 31. Showing supernumerary molar unerupted.

Fig. 7—Lateral view No. 12. Showing supernumerary third molar just coming into wear.

Fig. 8—Oral aspect Mandibulae No. 12 and 29. Showing supernumerary third molars.

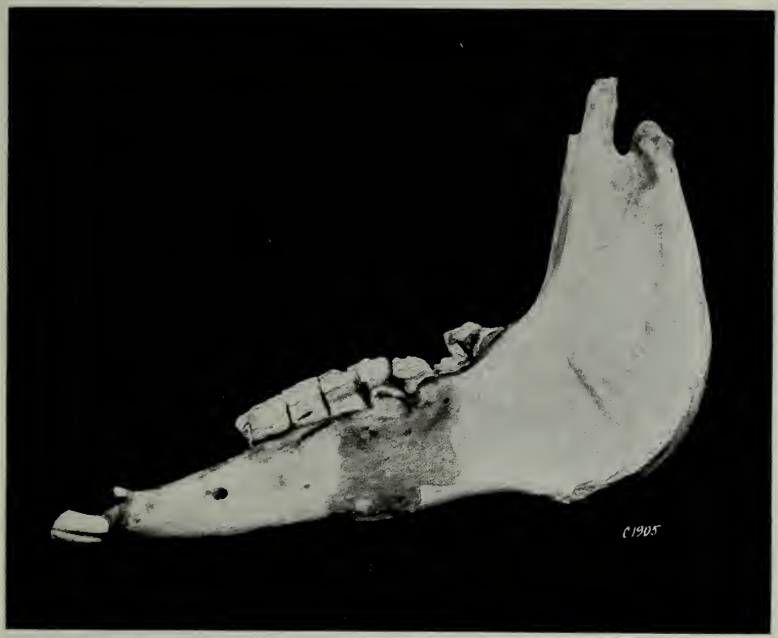


Fig. 9—Lateral view No. 29. Showing supernumerary third molar of mandible.

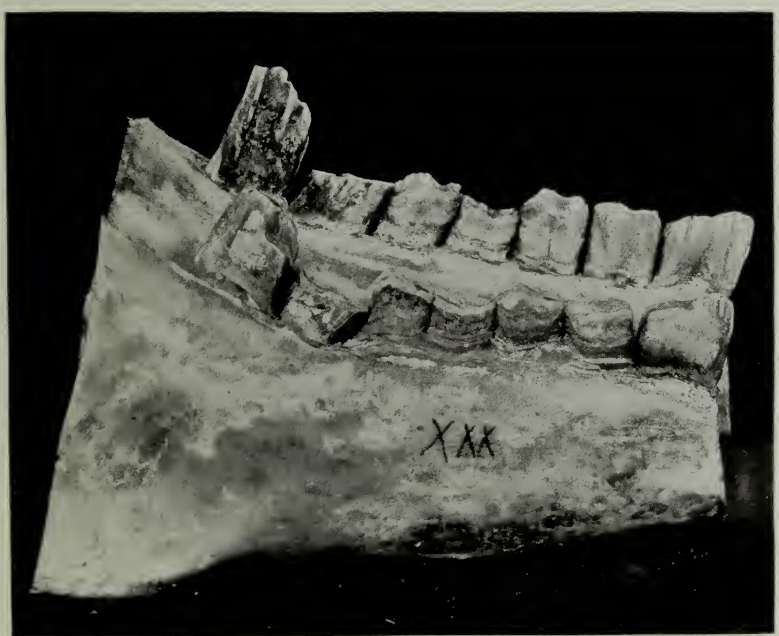


Fig. 10—Lateral view mandibulae No. 30. Showing supernumerary third molars.

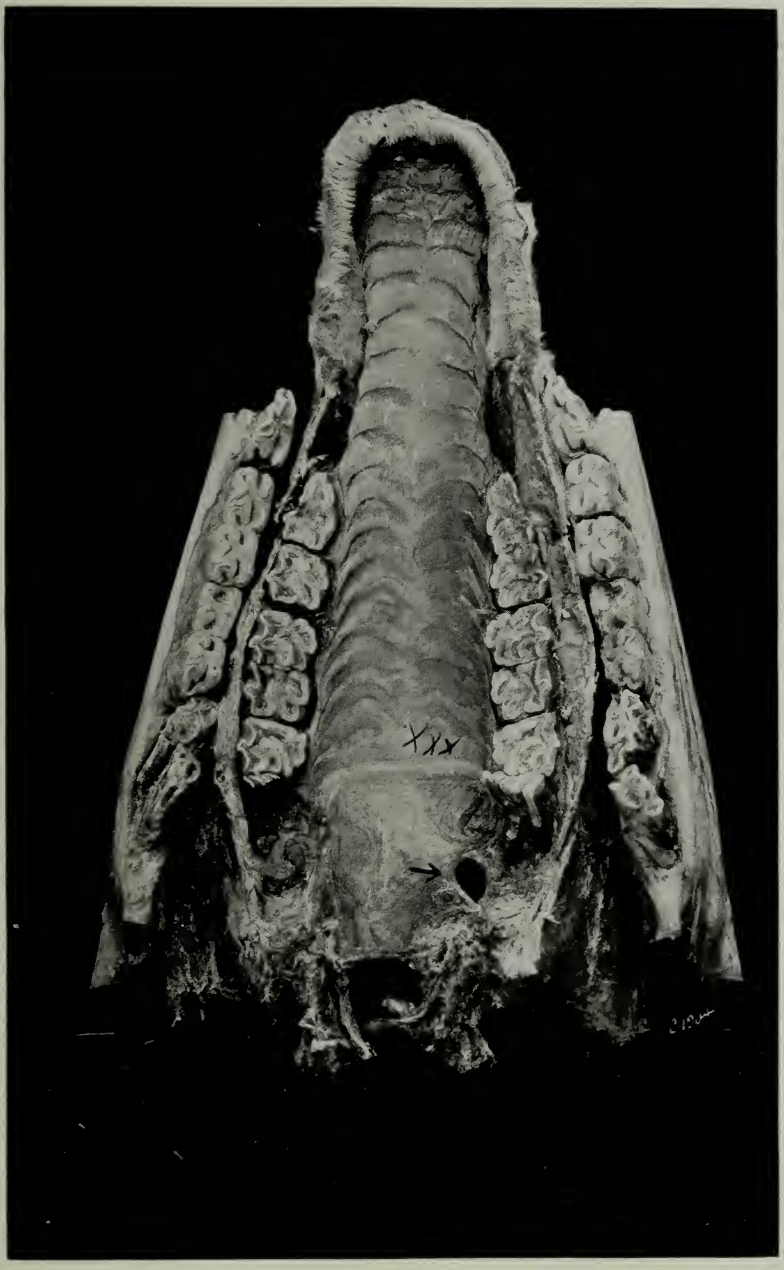

Fig. 11—Oral view of teeth and palate No. 30. Showing supernumerary third molar below and perforation of soft palate (indicated by arrow). See Fig. No. 10 also.

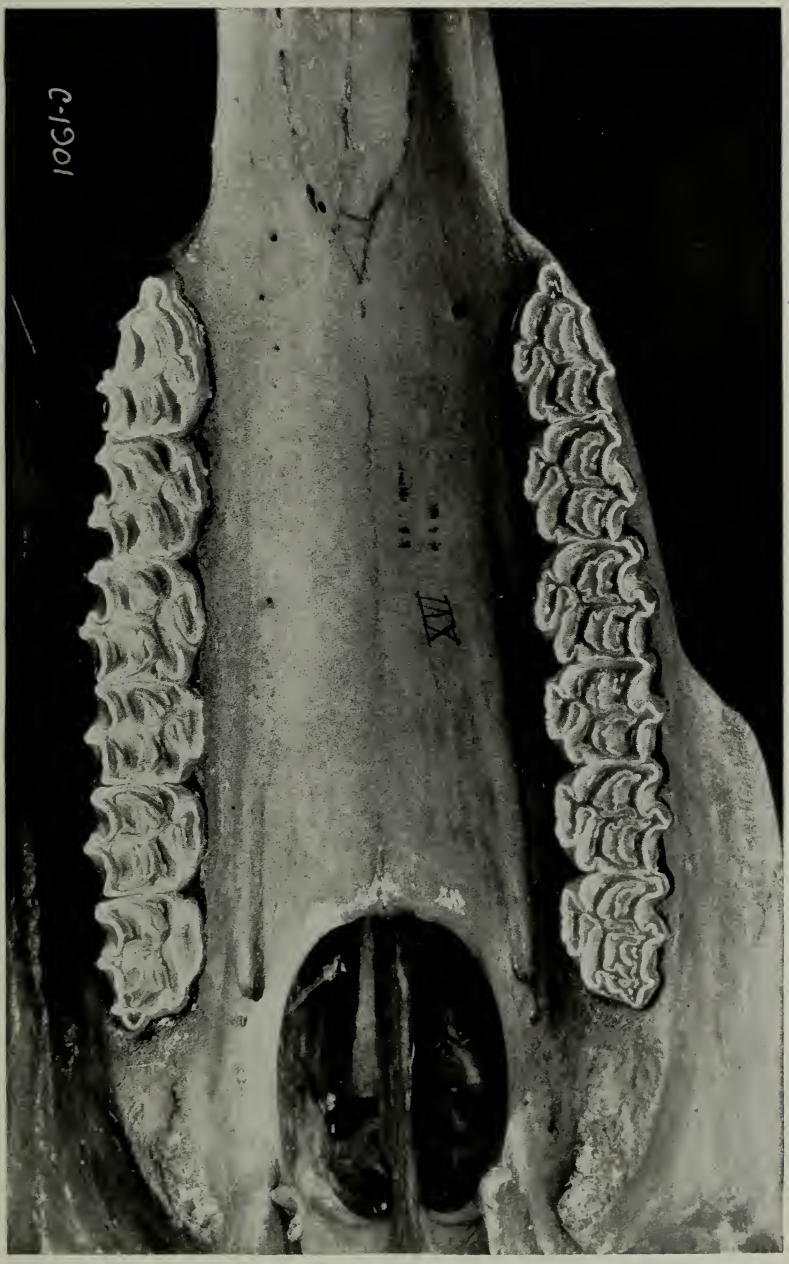


Fig. 12—Oral aspect superior cheek teeth showing complete, or perfect cementation.

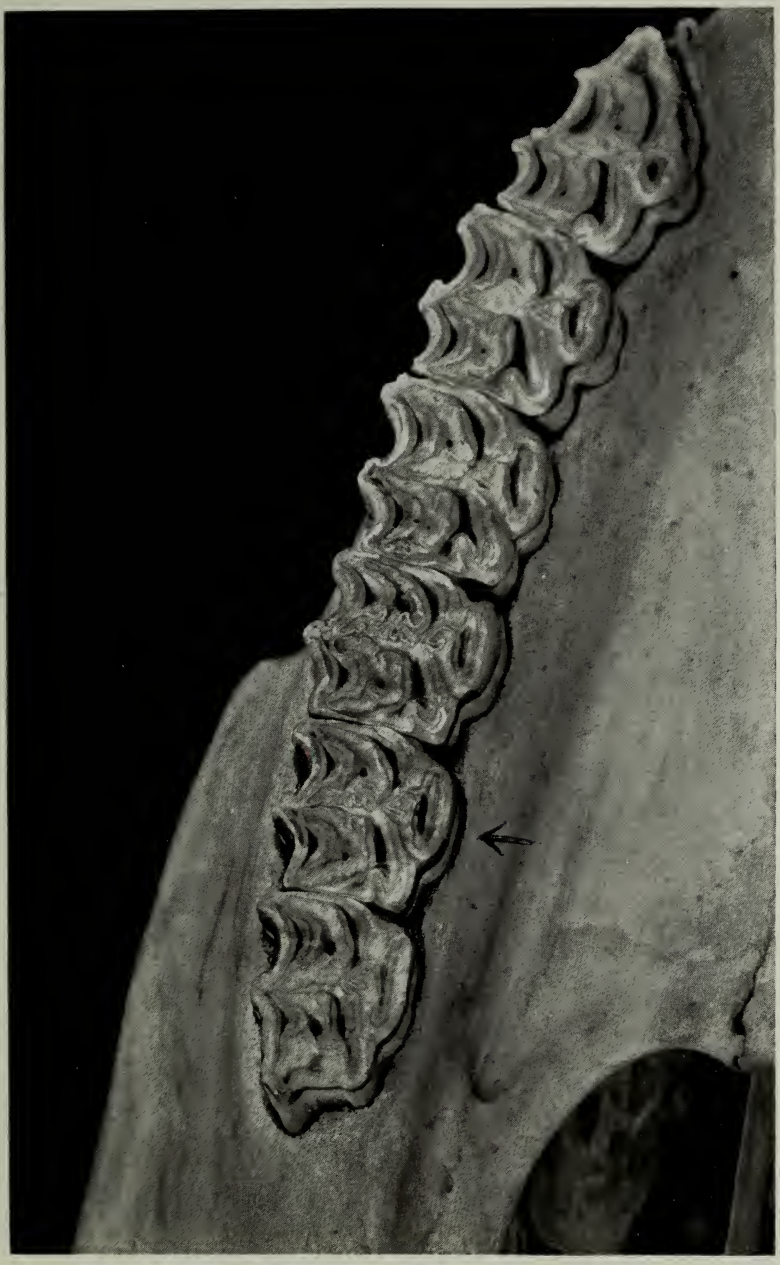

Fig. 13—Incomplete union of dentinal plates within antero-medial column of fifth cheek tooth. (Compare with fourth and sixth.)

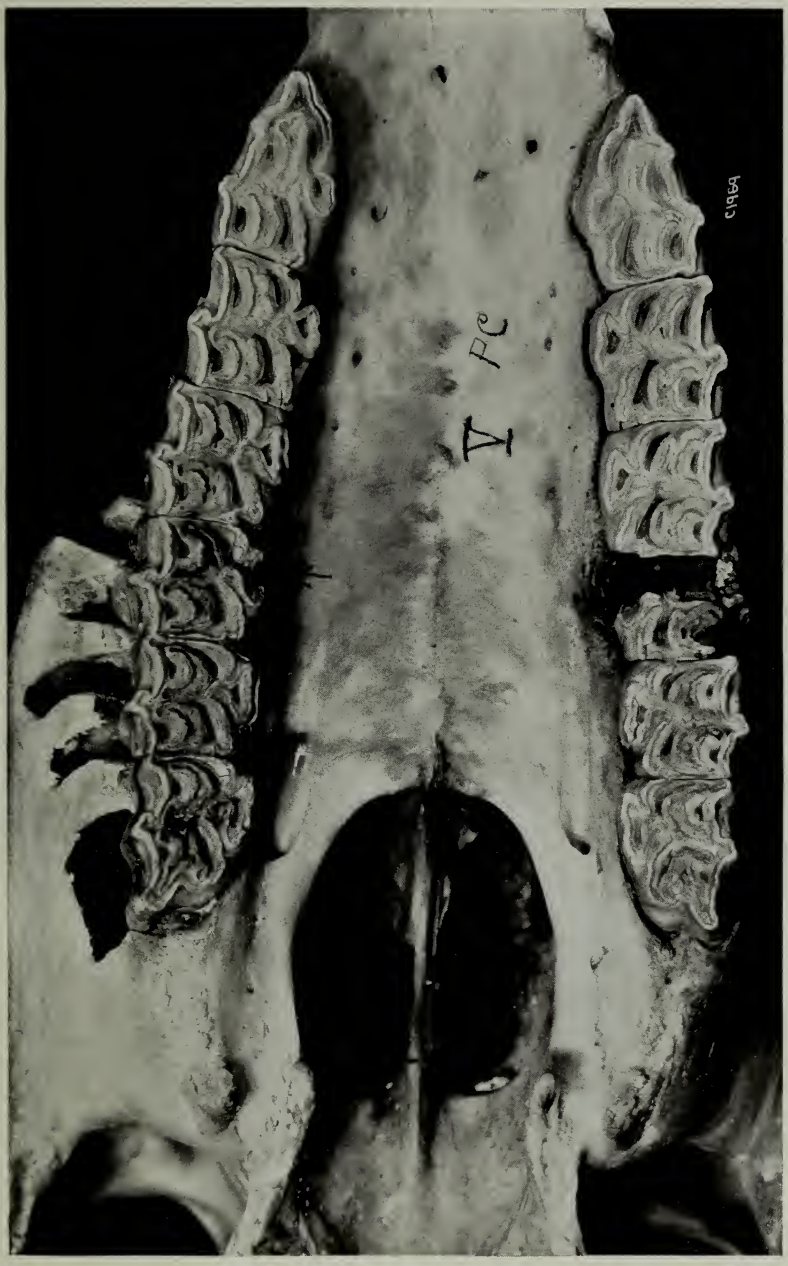


Fig. 14—Incomplete union of dentinal plates antero-medial column of fourth cheek tooth on right side, also cement defect of anterior infundibulum (both indicated by arrow) opposite broken tooth.

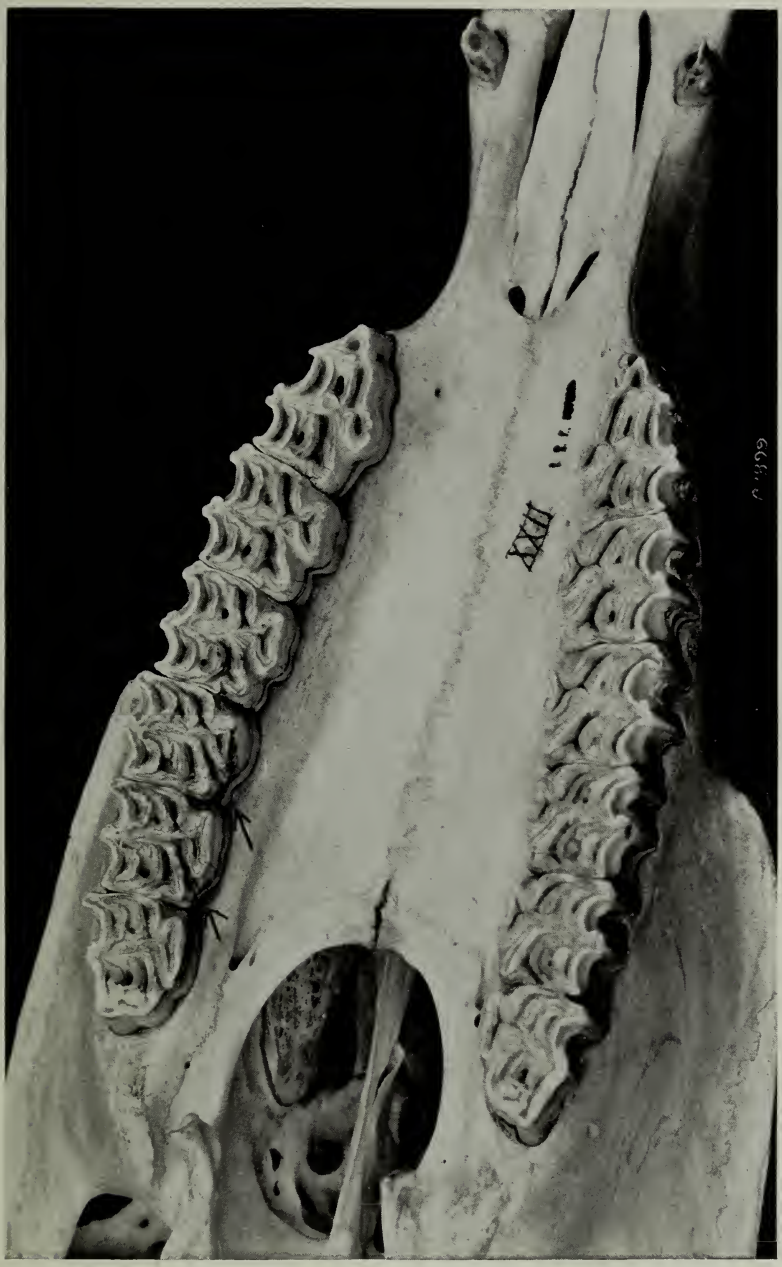

Fig. 15—Cement defect outside of outer enamel ring postero-lateral to accessory pillar of fourth and fifth cheek teeth (indicated by arrow).

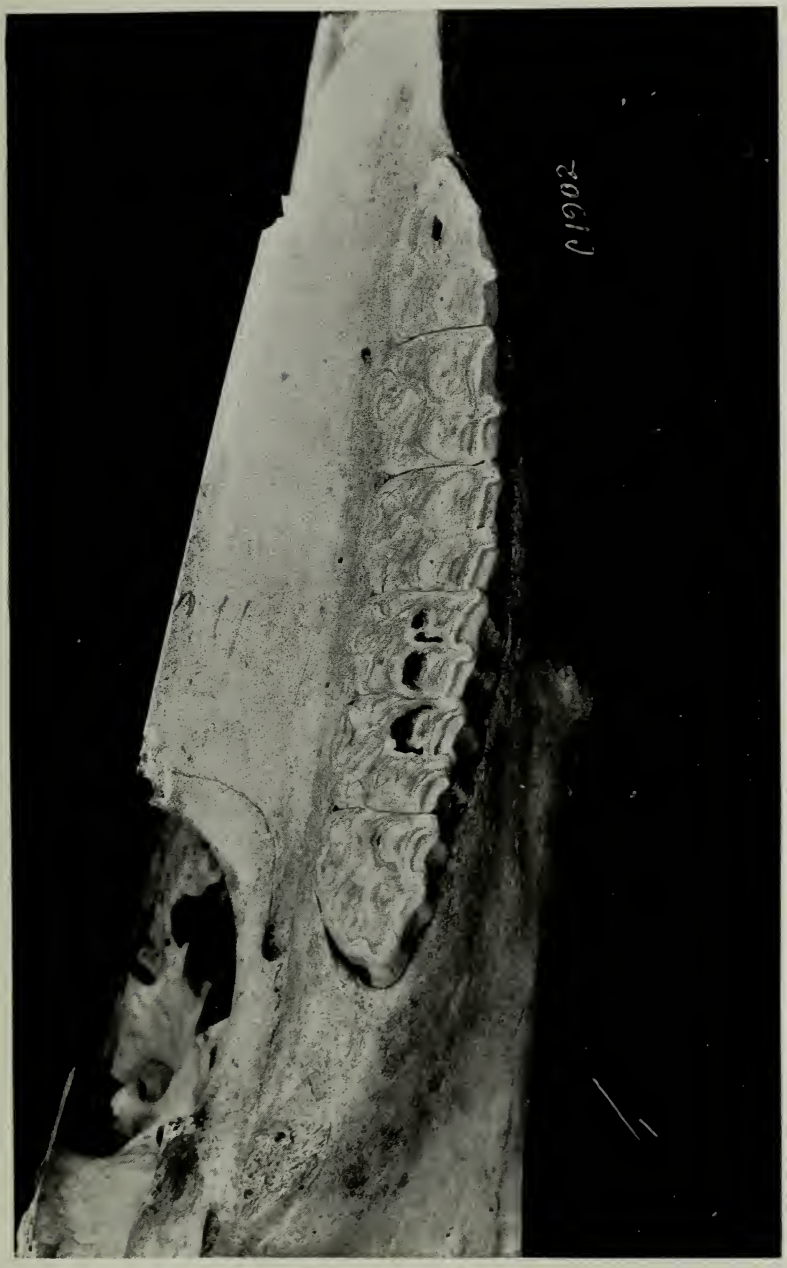

Fig. 16—Cement defect, infundibuli of first, fourth and fifth cheek teeth.

Fig. 17—Dorsal view of head. Note Fig. 18.

Fig. 18—Dorsal view of horizontal section of head, to show anterior boundary of frontal sinus (arrow), fronto-maxillary opening (medial to X) and nasal cavity from above.

Fig. 19—Lateral view of malar and maxilla of a new born foal showing first molar in its original position under the orbit.

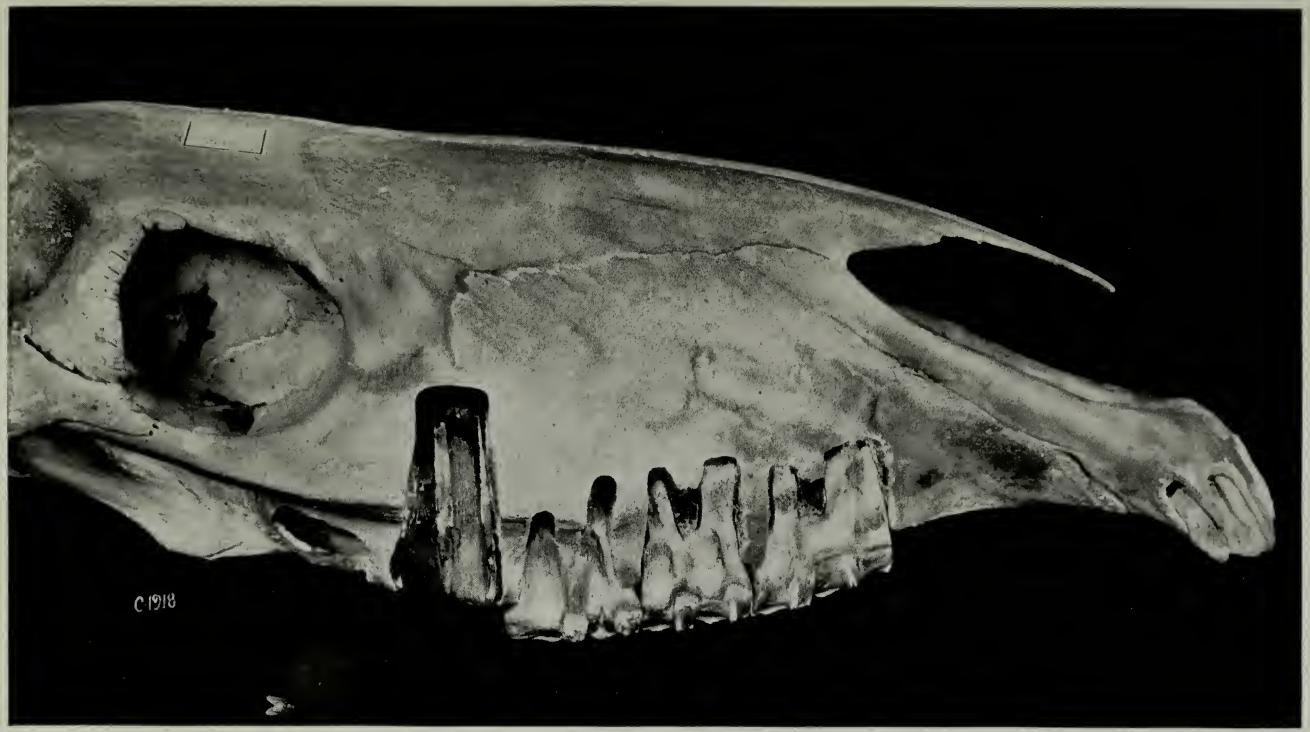


Fig. 20—Lateral view of six months' old head sculptured to show teeth.

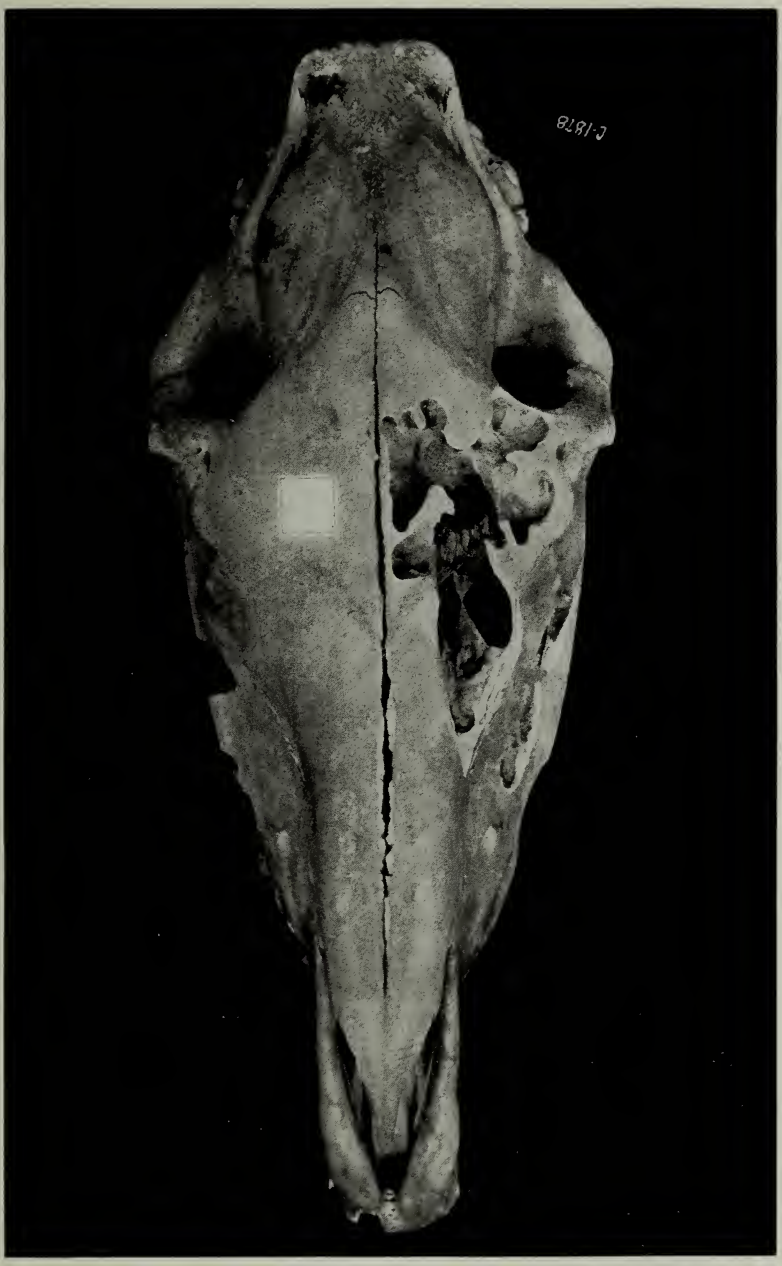


Fig. 21—Dorsal view of head sculptured to show sinuses and position of teeth at six months.

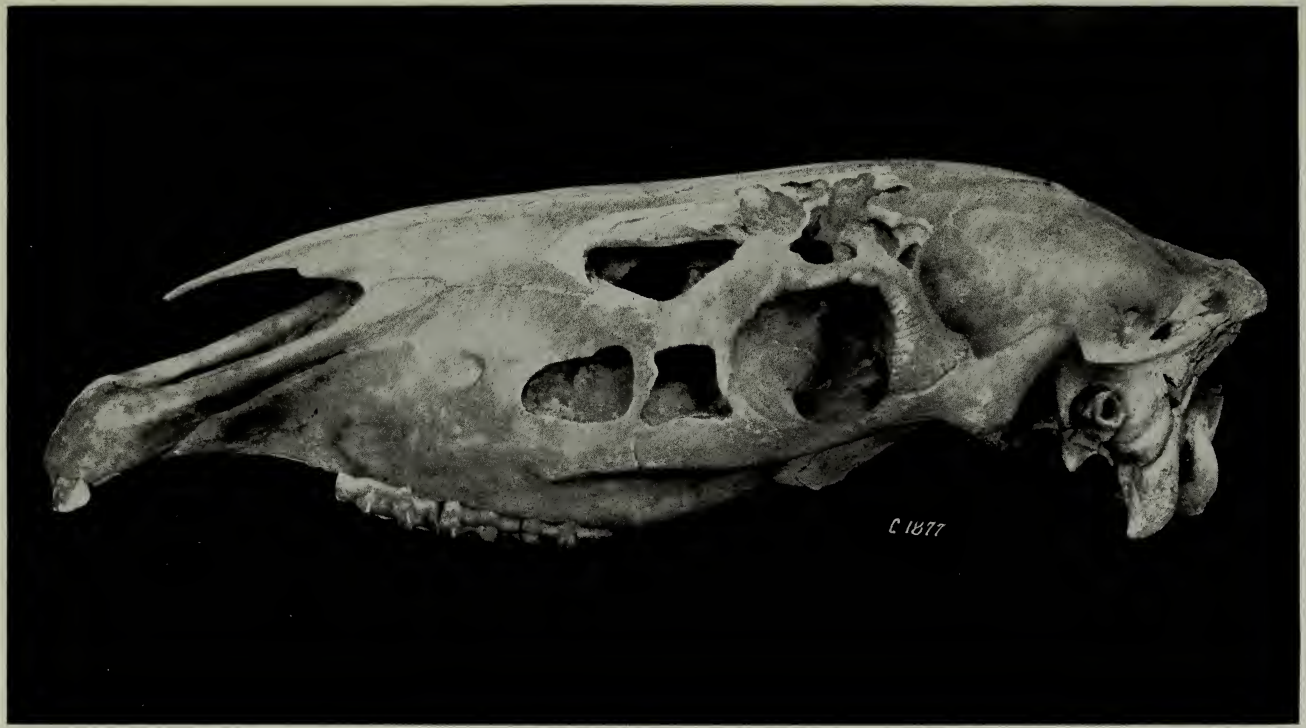


Fig. 22—Lateral view showing sinuses at six months.

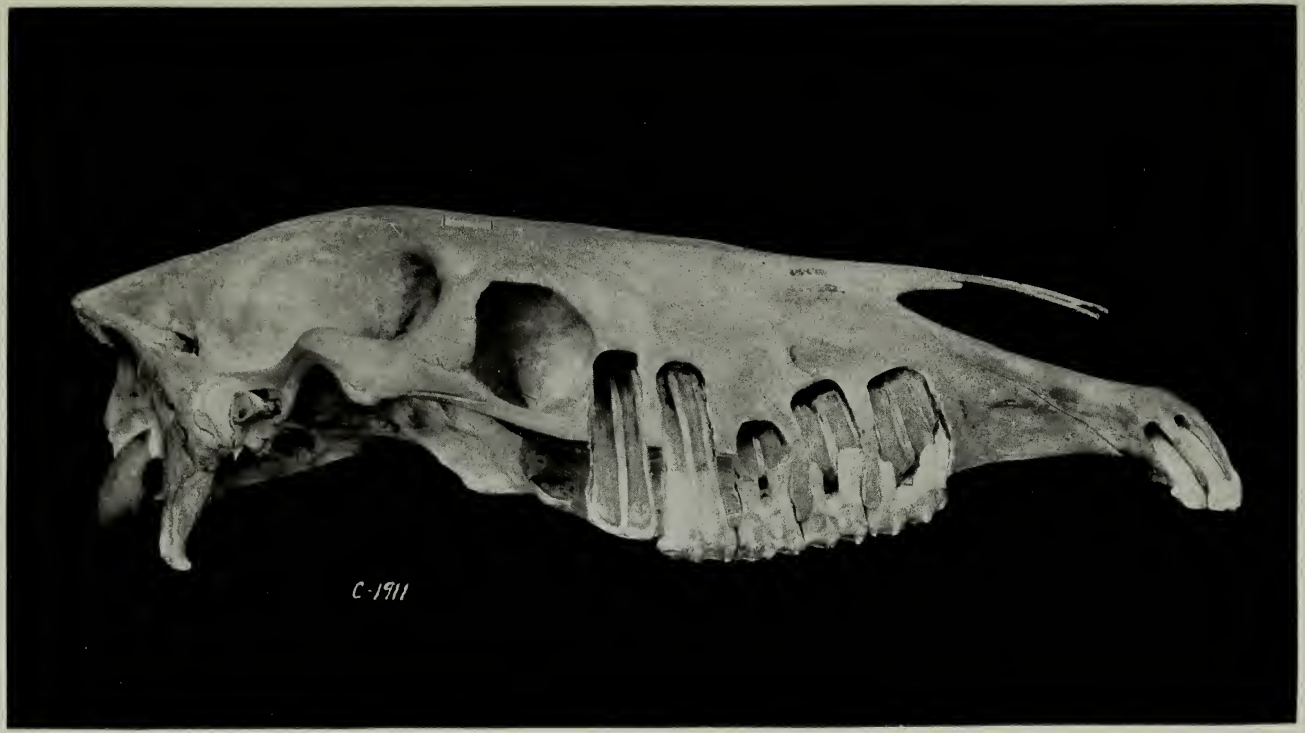


Fig. 23—Lateral view of sculptured head showing teeth at fifteen months.

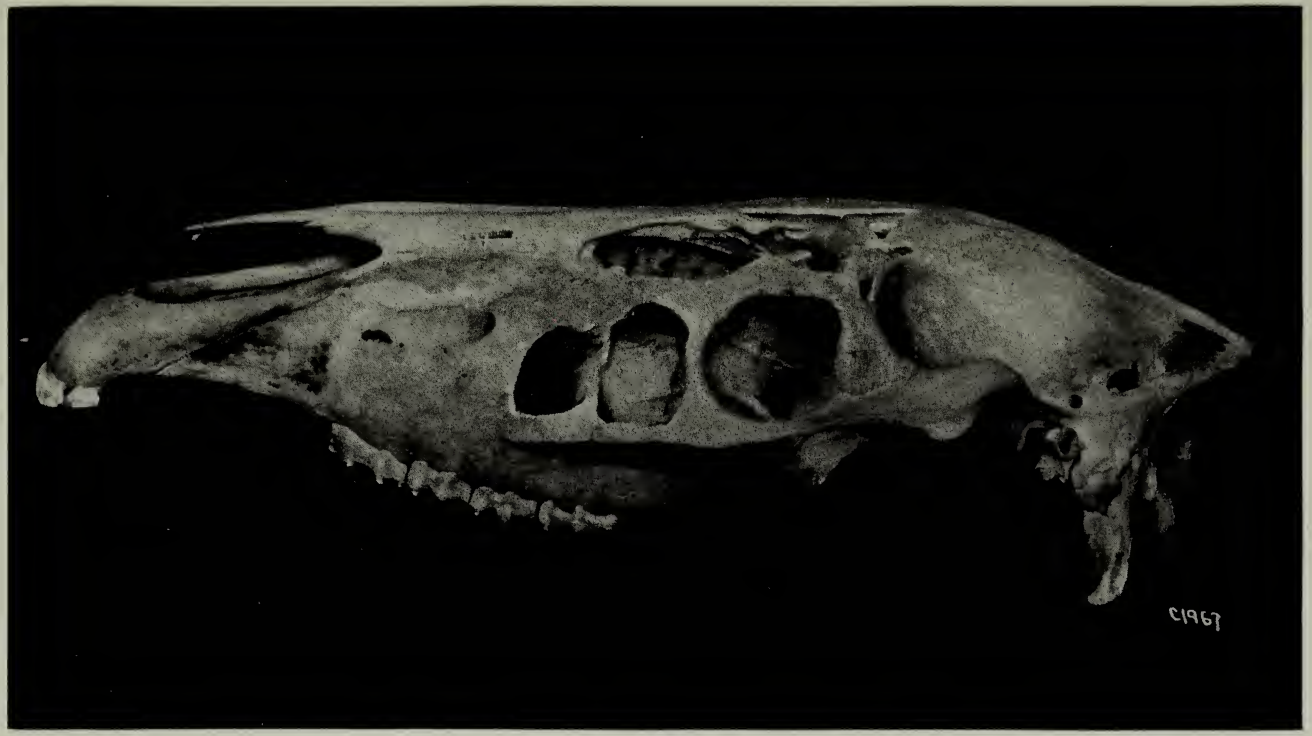


Fig. 24—Lateral view head sculptured to show sinuses at fifteen months.

Fig. 25—Dorsal view of head sculptured to show sinuses and position of teeth at fifteen months.

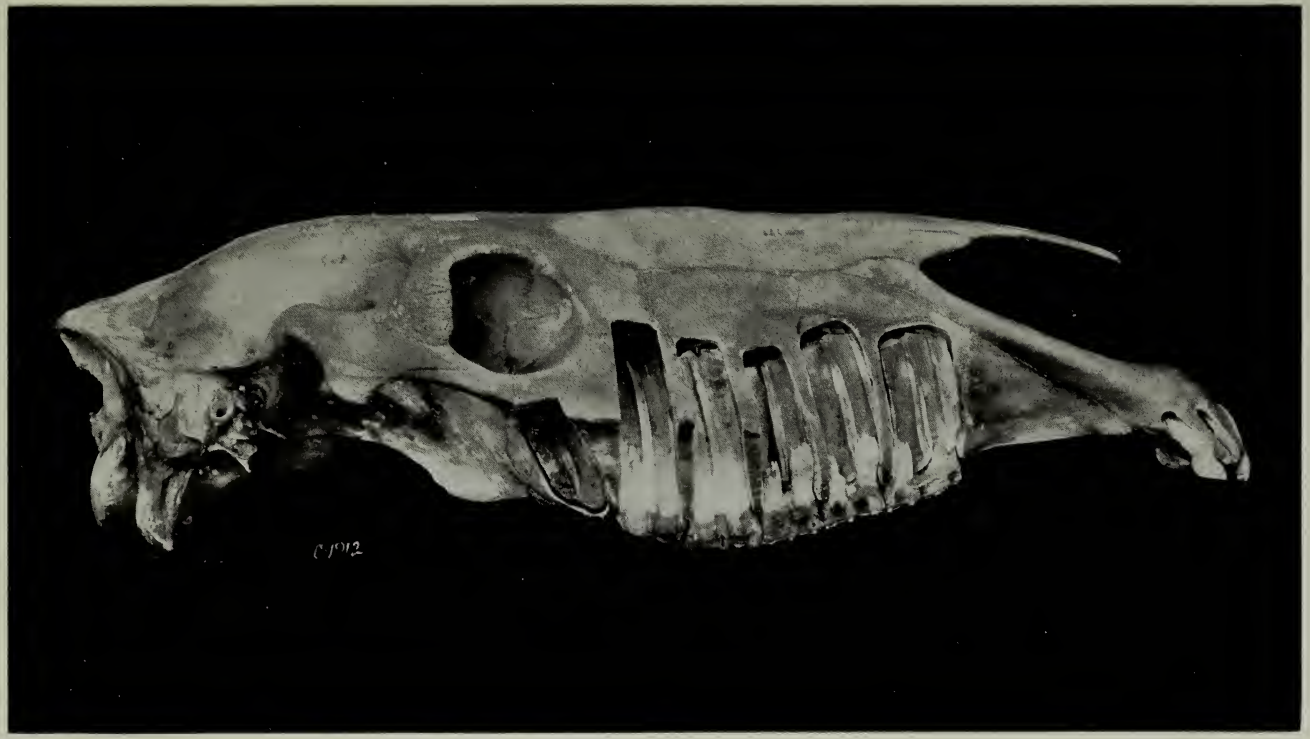

Fig. 26—Lateral view head, sculptured to show the teeth of two-year-old.

Fig. 27—Lateral view head, sculptured to show sinuses of two-year-old.

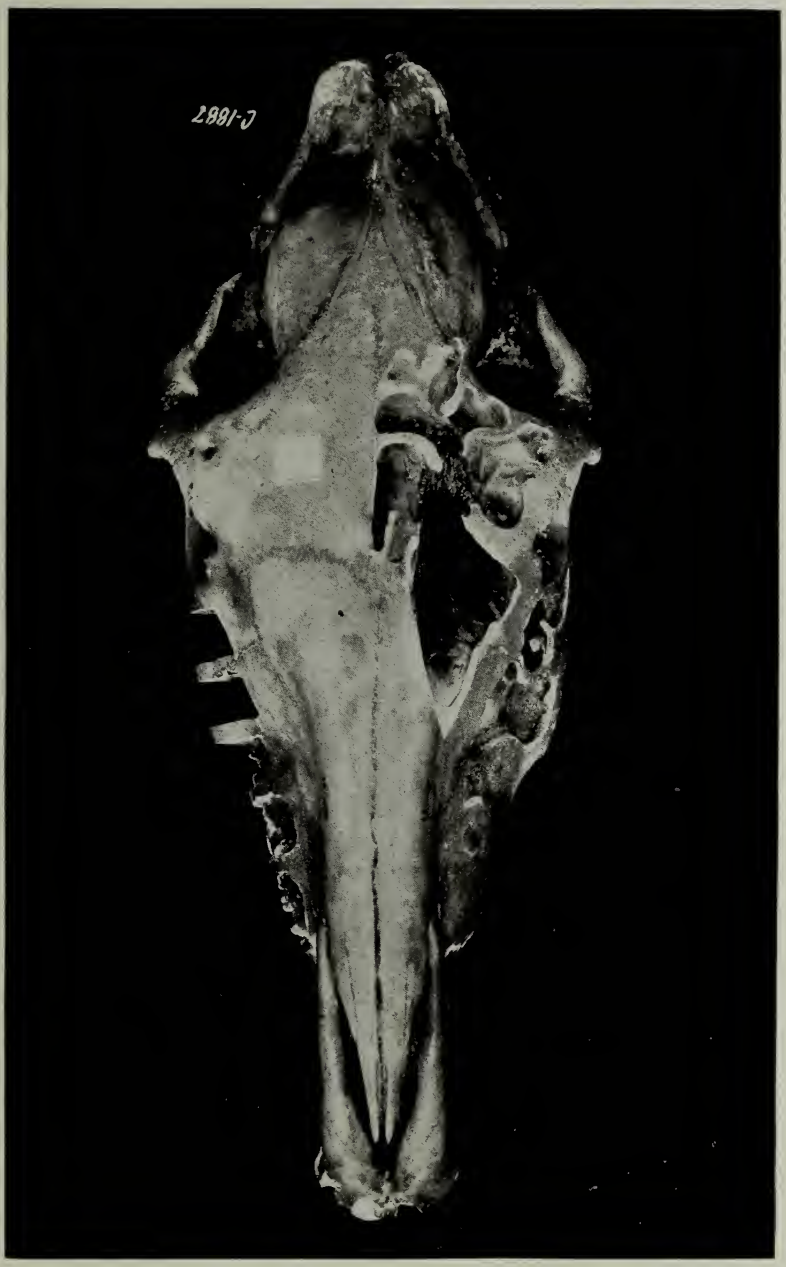


Fig. 28—Dorsal view of head sculptured to show sinuses and position of the teeth of a two-year-old.

Fig. 29—Lateral view of head sculptured to show the teeth at 3½ years (the first molar is loose and has dropped a short distance).

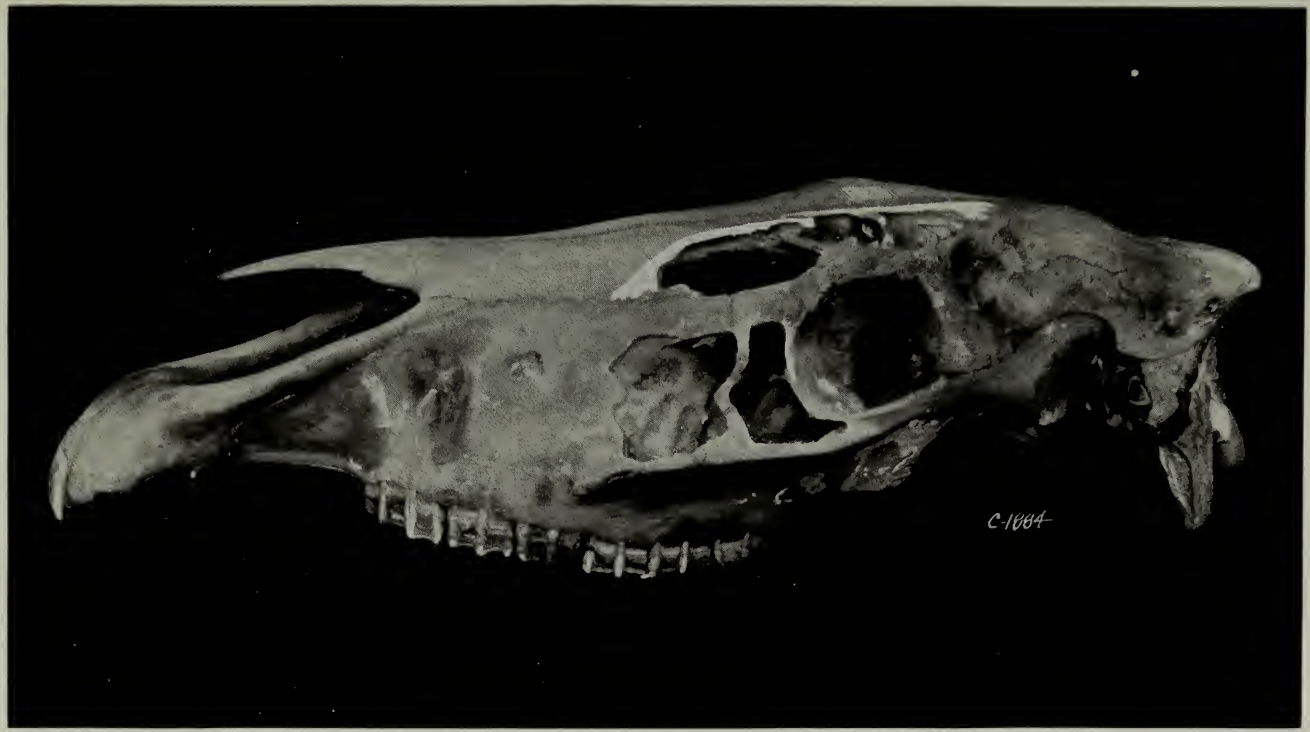


Fig. 30—Lateral view of head sculptured to show sinuses of 3½-year-old. Note anterior extent of maxillary sinus and septum between the two compartments.

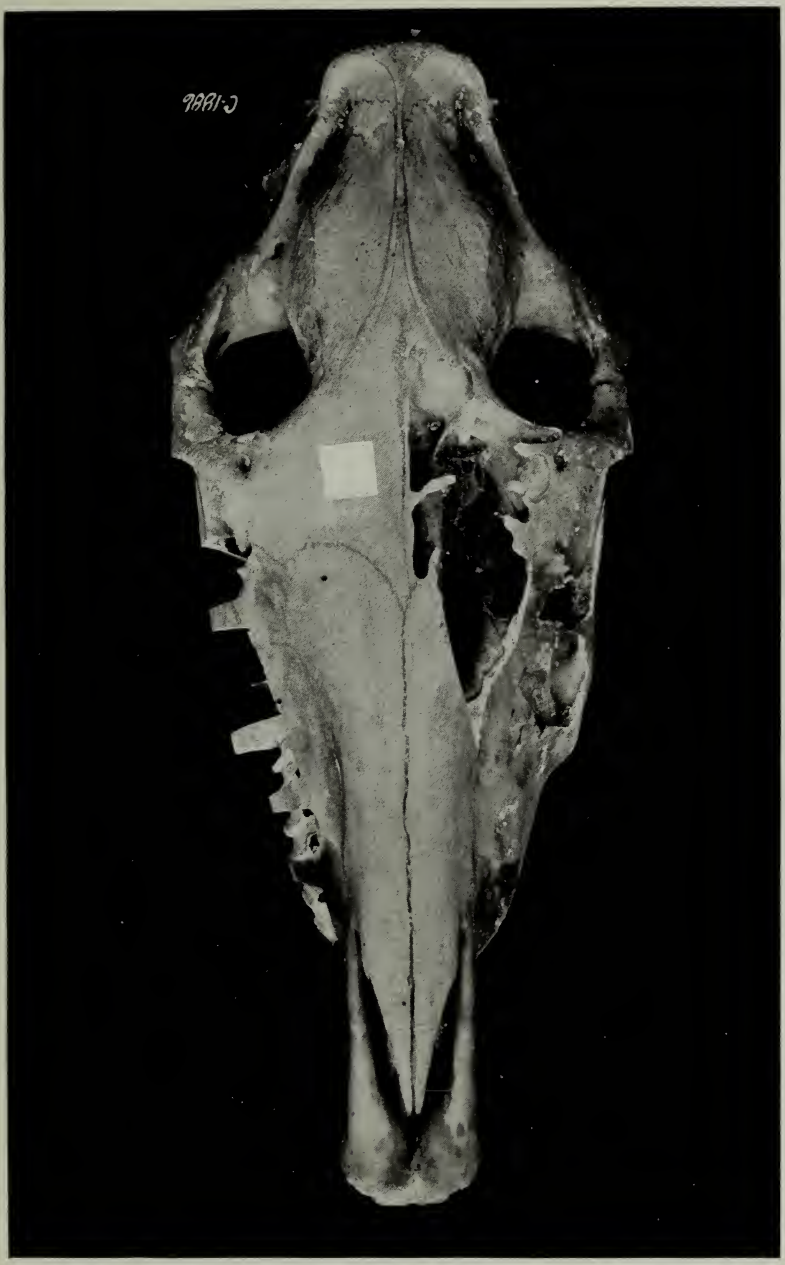

Fig. 31—Dorsal view of head sculptured to show sinuses and position of teeth at 3½ years.

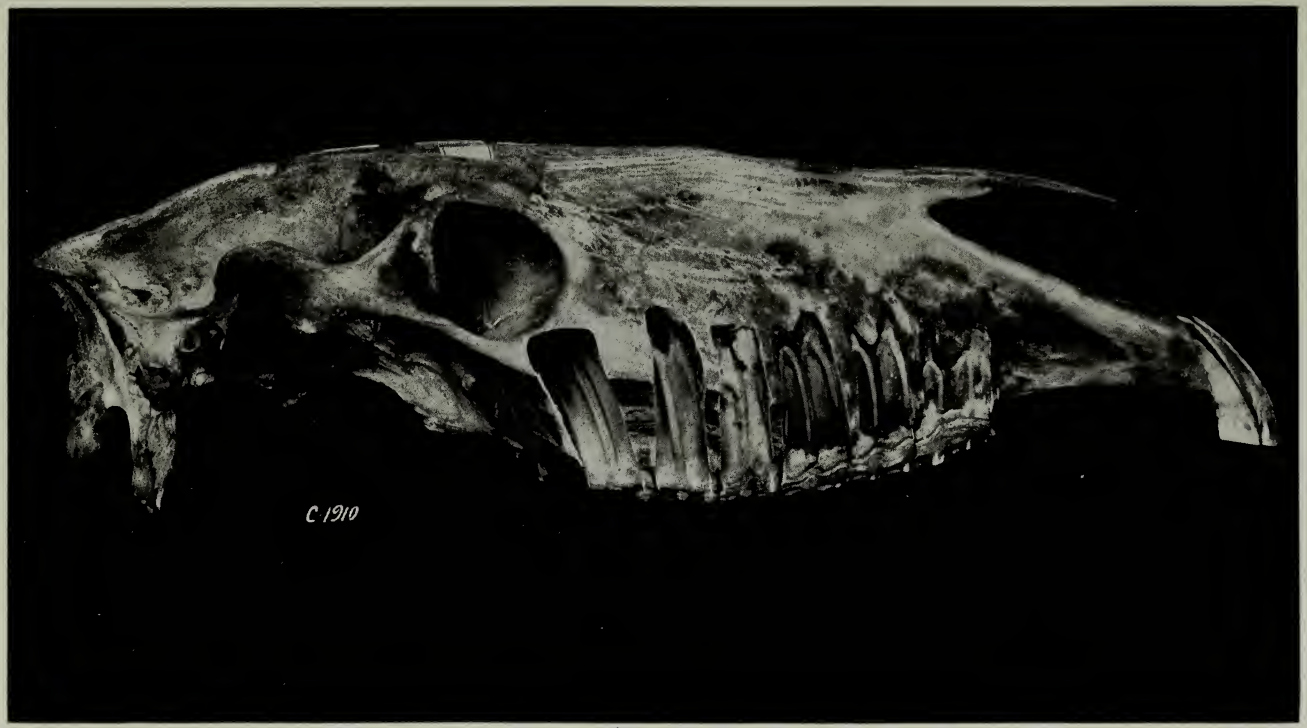


Fig. 32—Lateral view showing teeth of a six-year-old.

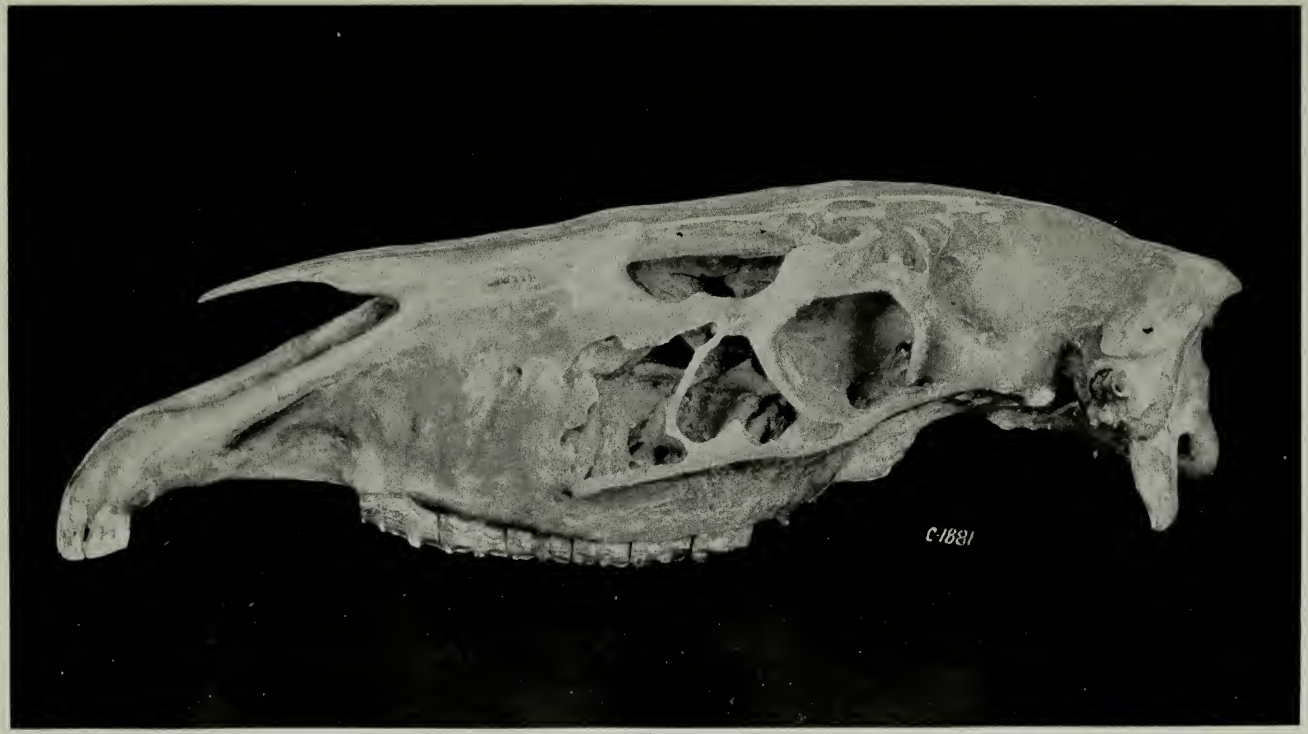


Fig. 33—Lateral view of head sculptured to show the sinuses of a six-year-old.

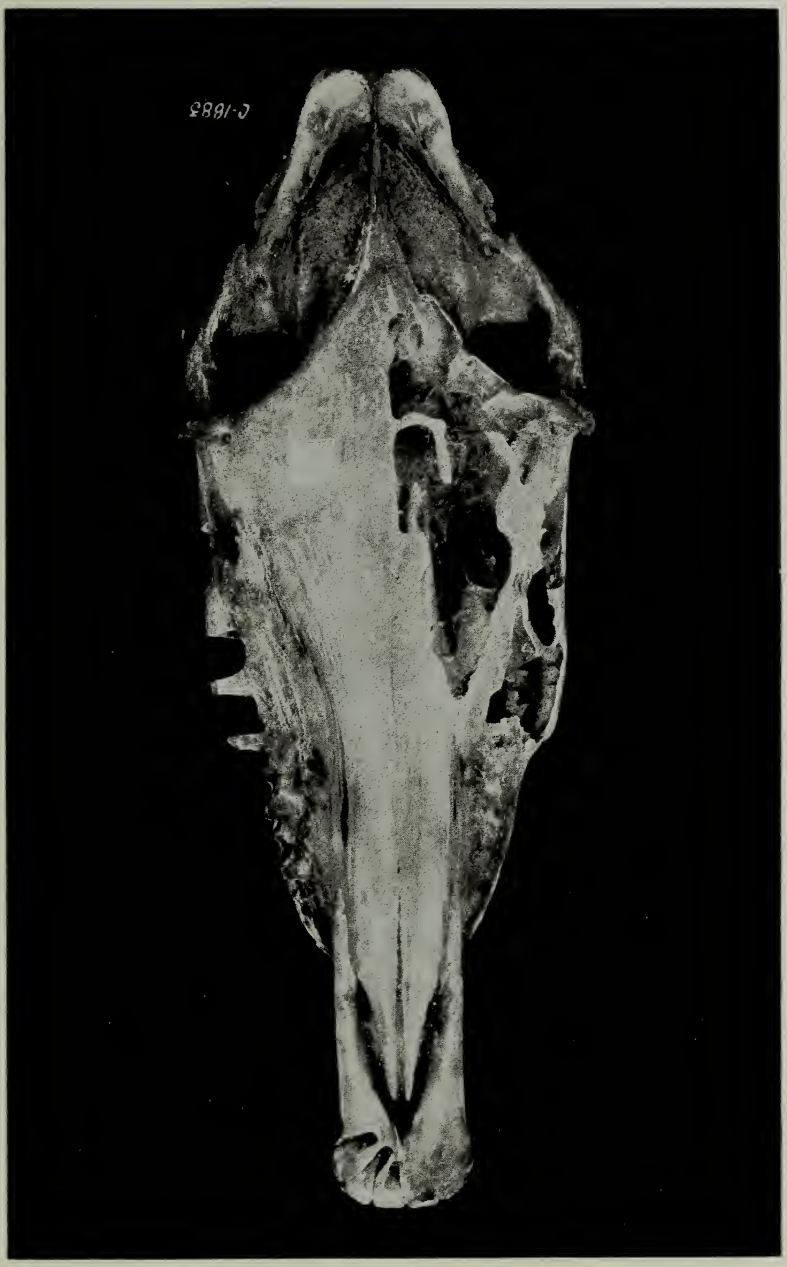


Fig. 34—Dorsal view of head sculptured to show the sinuses and position of the teeth at six years of age.

Fig. 35—Lateral view of eight-year-old skull, sculptured to show teeth and lacrimal canal.

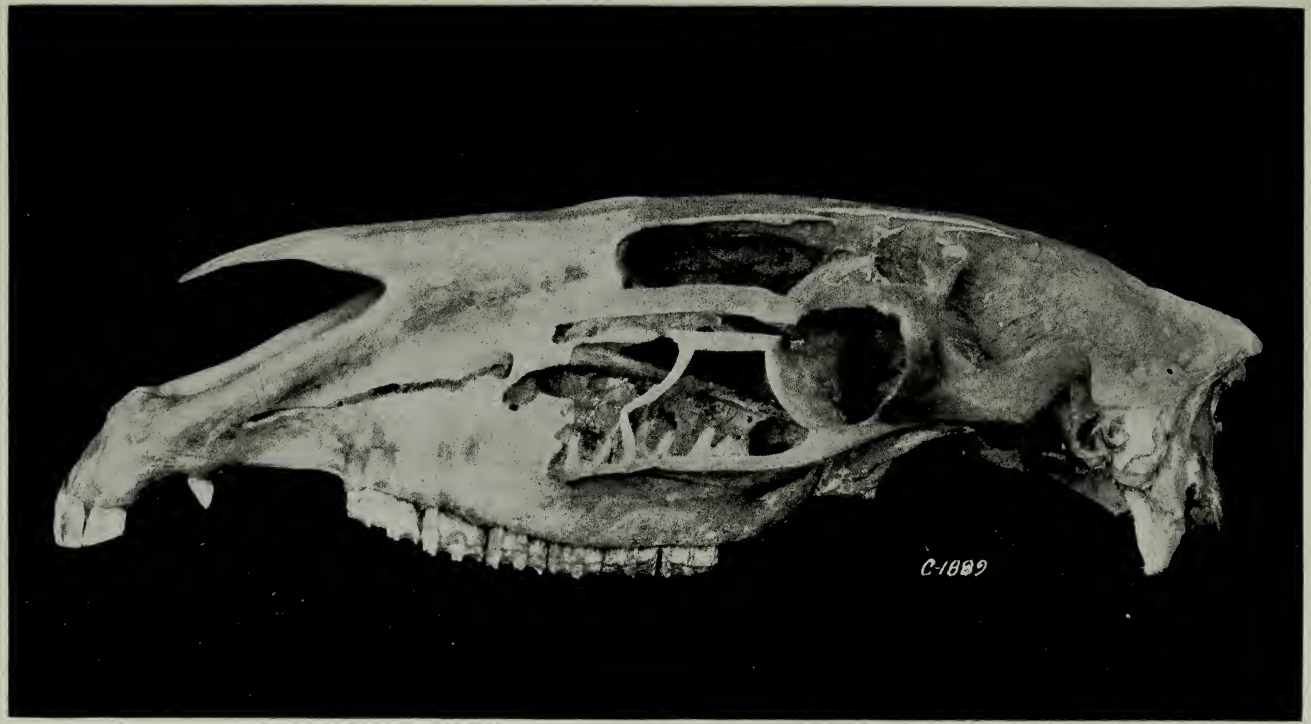


Fig. 36—Lateral view of sculptured eight-year-old head showing sinuses, roots of molar teeth, lacrimal canal, and canalis alveolaris incisivus.

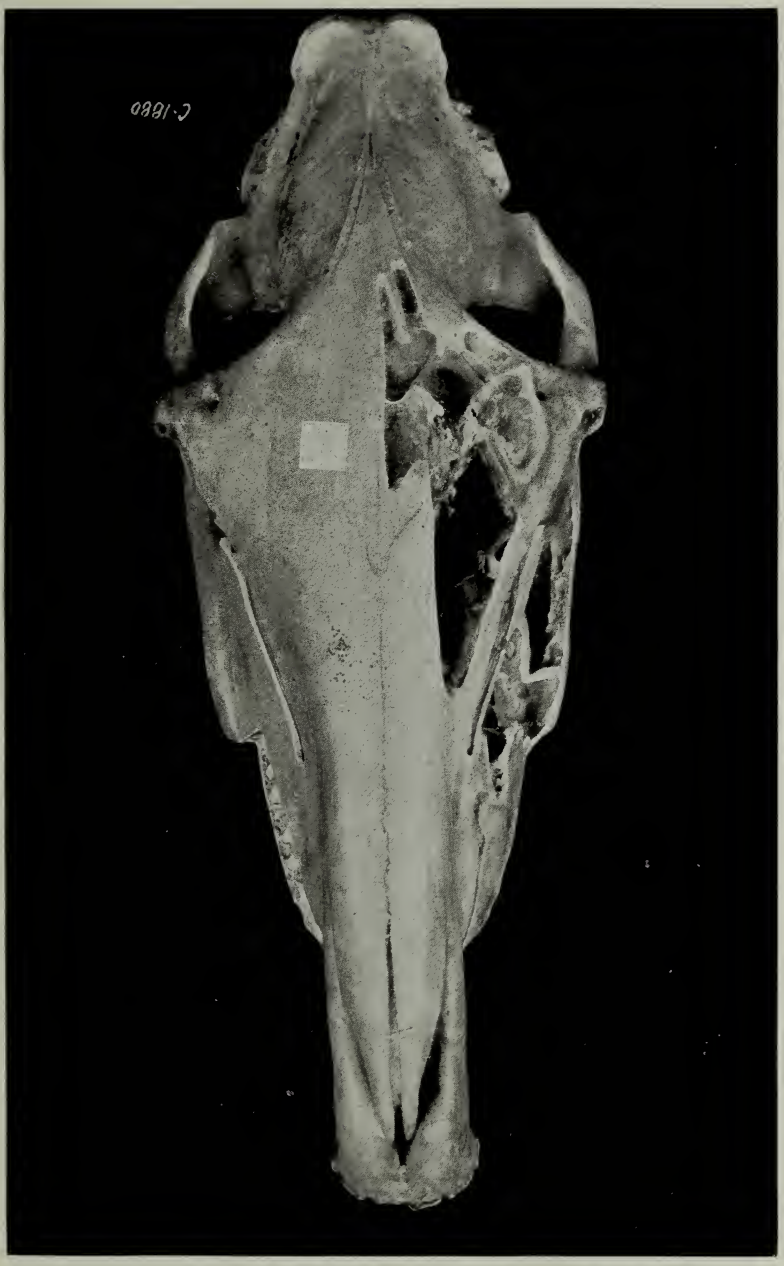

Fig. 37—Dorsal view of eight-year-old head, sculptured to show sinuses, teeth and lacrimal canal.

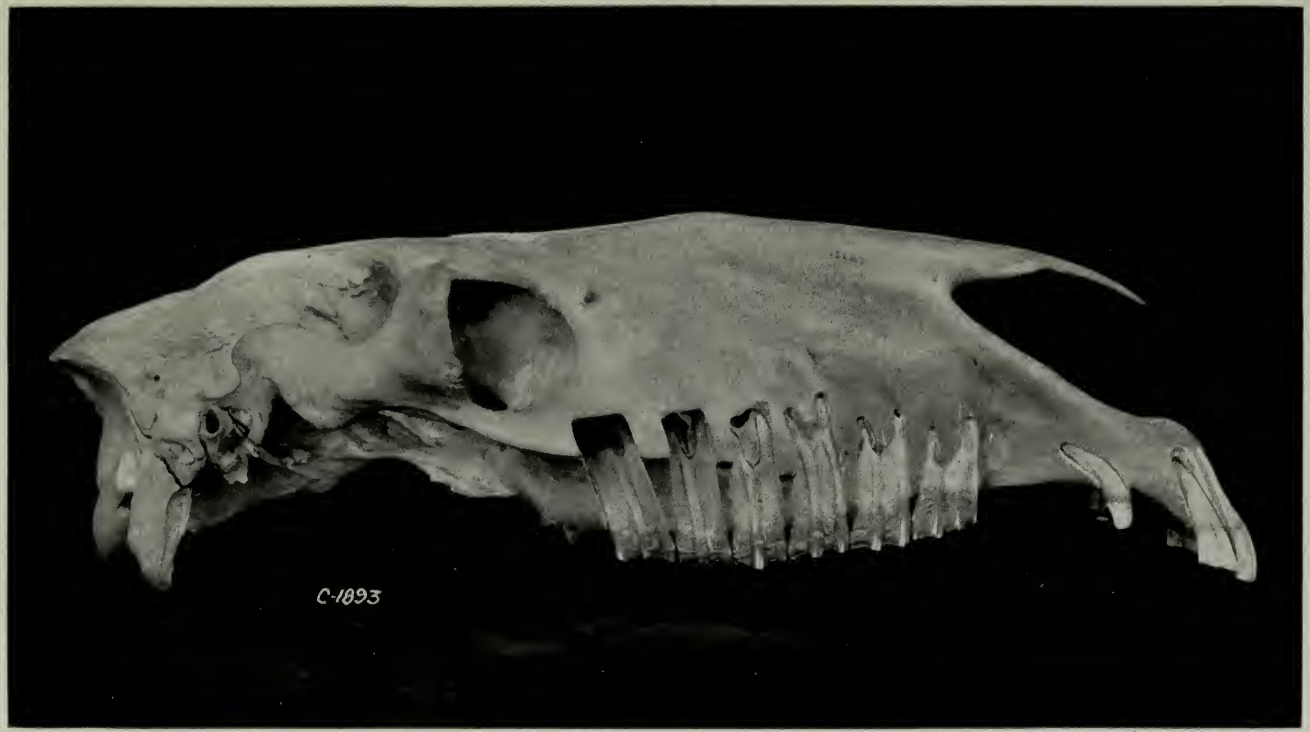


Fig. 38—Lateral view of twelve-year-old head showing the teeth.

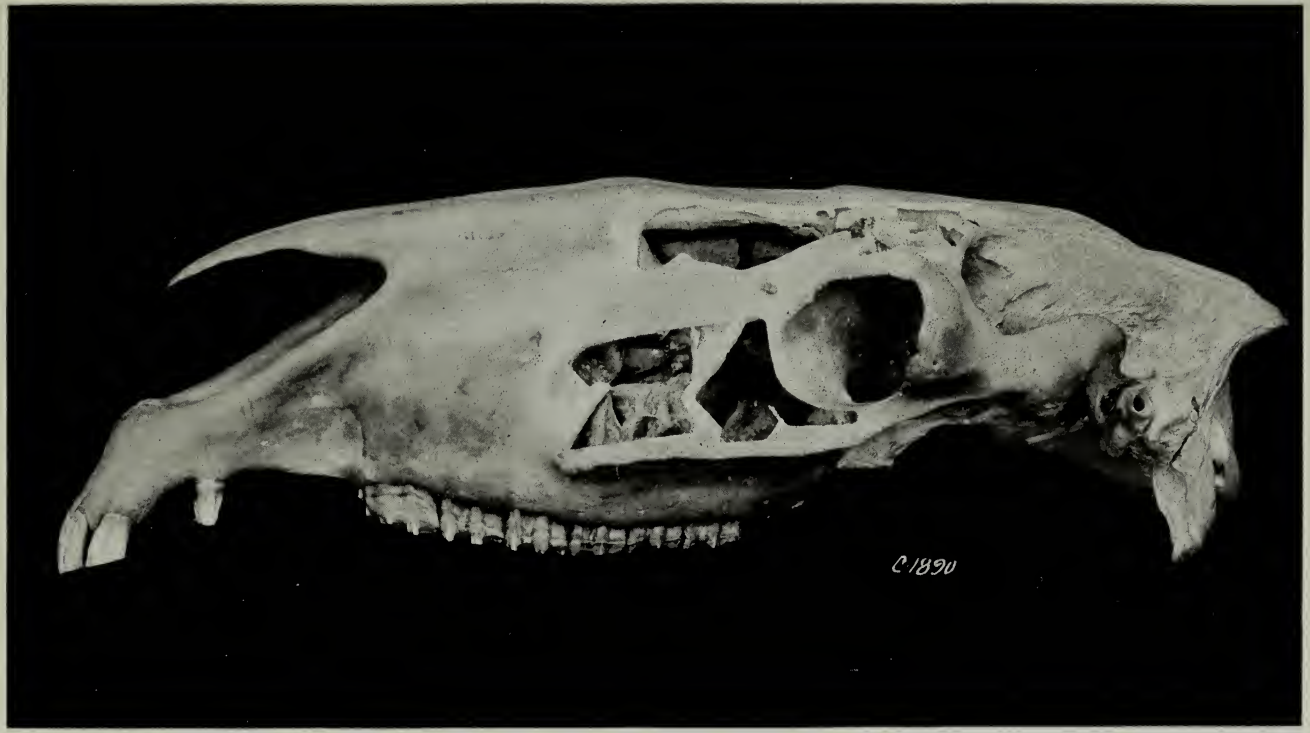


Fig. 39—Lateral view of twelve-year-old head, sculptured to show sinuses. Note septum between the compartments of the maxillary sinuses.

Fig. 40—Dorsal view of twelve-year-old head sculptured to show sinuses and position of the teeth.

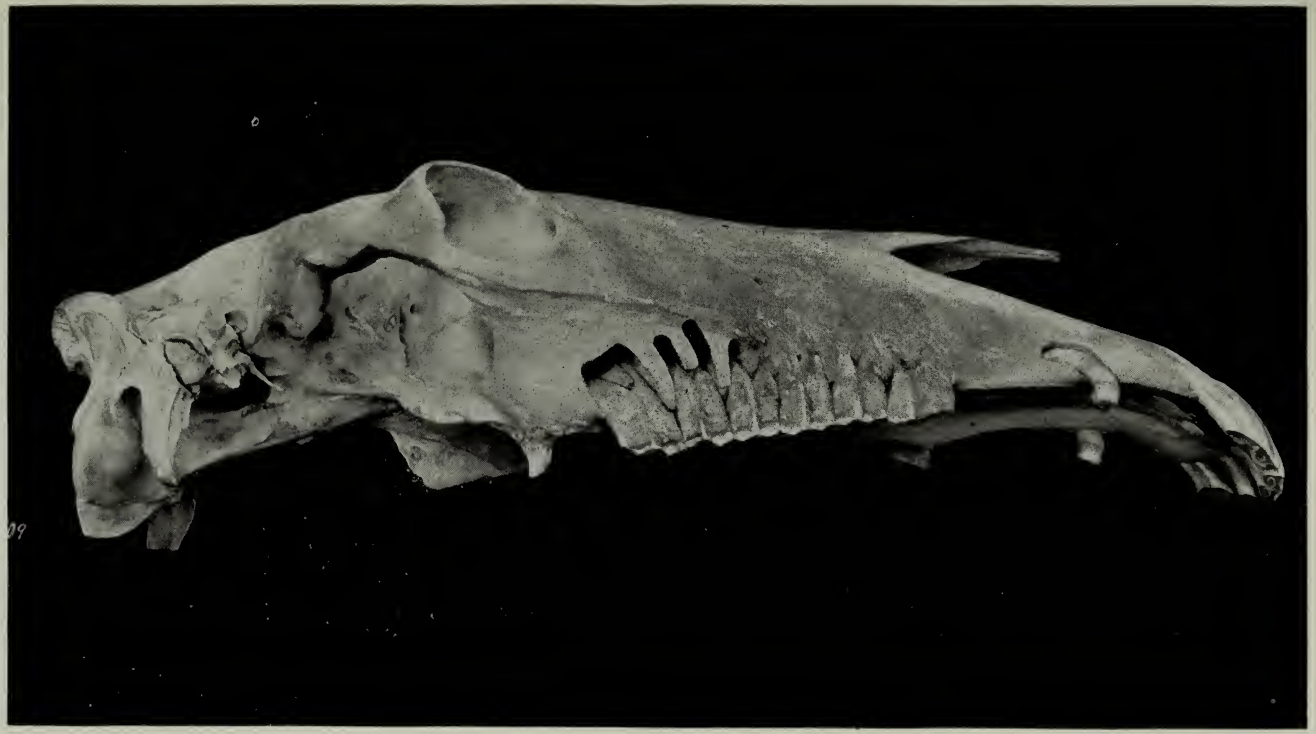

Fig. 41—Lateral view of a twenty-year (?) old head to show teeth.

Fig. 42—Lateral view of twenty-year (?) old head sculptured to show sinuses.

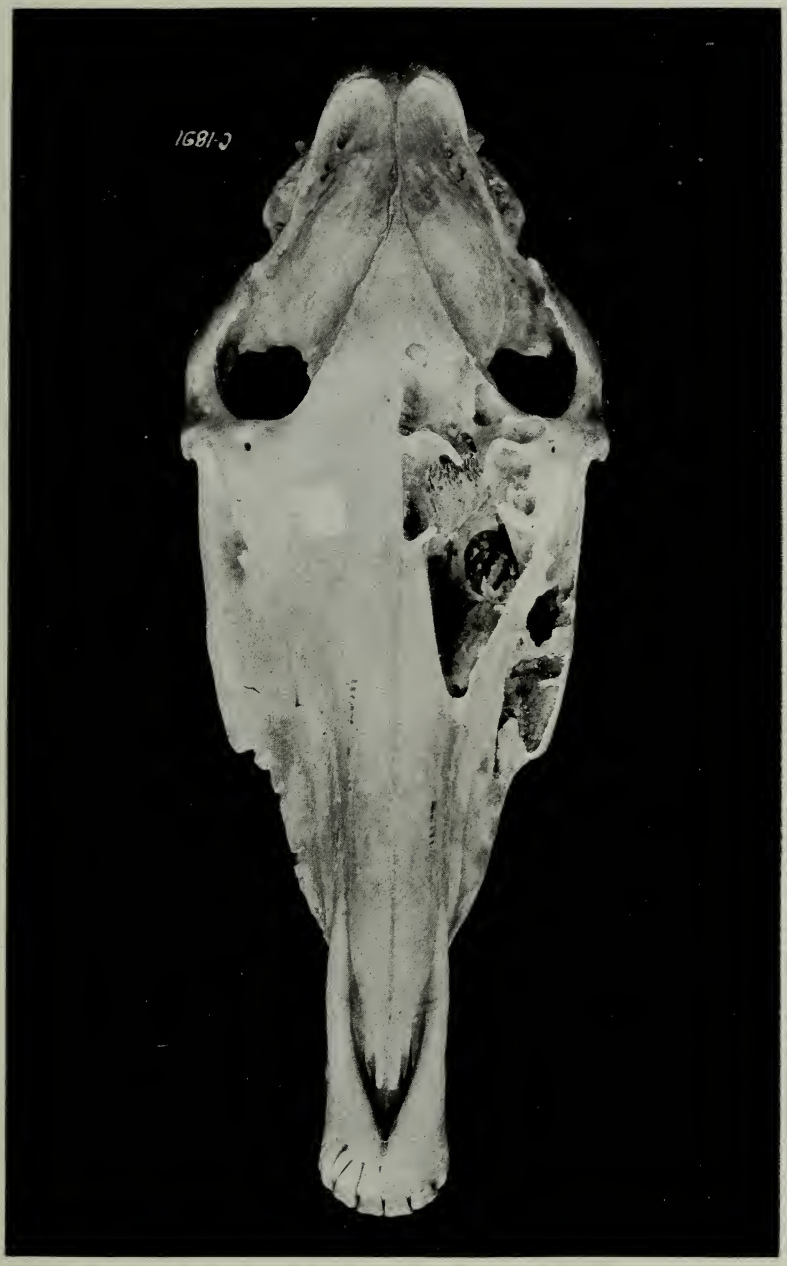


Fig. 43—Dorsal view of twenty-year (?) old head to show sinuses and position of teeth.

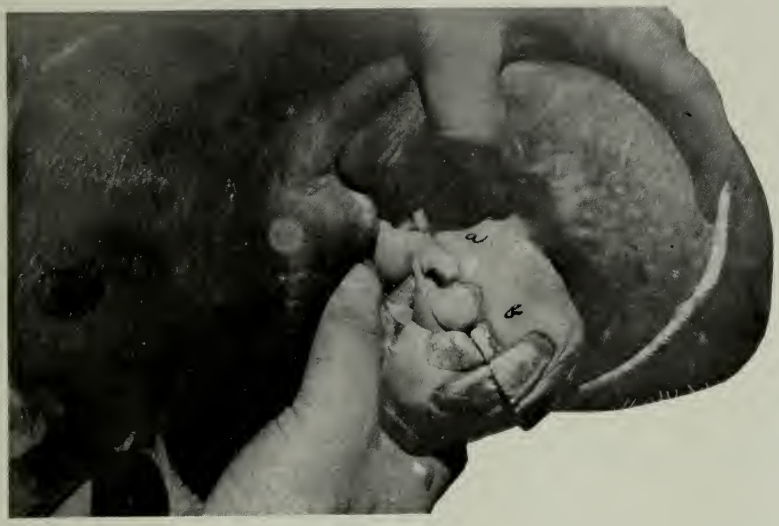


Fig. 44—Supernumerary incisor, (a), back of corner, and retained deciduous; (b), between intermediate and corner incisor.

Fig. 45—Supernumerary incisor, (a), between intermediate and corner incisor.

A "typical tooth" presents the following parts:

1. The crown, the visible portion above the gum, which is covered by a shell of enamel with a central basis of dentin.
2. The neck, a constricted portion surrounded by the gum.
3. The root, the portion which is imbedded in the bone (alveolus). It has a coat of cementum, a basis of dentin which is continuous through the neck with that of the crown. The central portion or pulp cavity is filled by embryonic connective tissue containing blood vessels and nerves. Next to the dentin is found a row of cells, the odontoblasts which deposit dentin as the tooth grows older, thus filling the cavity centripetally. At the end of the root is the apical foramen. (Examples: canine and human teeth, and the incisors of ox.) In all of the permanent teeth of the horse and in the cheek teeth of the ox, we recognize a functional crown above the gum and a reserve crown below the gum (imbedded portion). The roots proper begin to develop in the cheek teeth of the horse at five years and are complete at twelve to fourteen (Sisson[1]). Table No. 1 shows those of the first molar forming at two years.

The incisors of the equidae are curved pyramids with the following characteristics. There is originally no root, all of the imbedded portion being reserve crown. The outer portion is covered by cementum. Infundibuli are present, which may be described as oral indippings of enamel that carry the dentin with them, the outer cavity being filled more or less by cementum. The indipping equals approximately one-half the total length of the tooth (for exact measurements see Meek[2]). The oral portion of the teeth in cross-sections show:

1. A covering of cementum.
2. The outer enamel ring.
3. The two fused plates of dentin, (which are separated by the pulp cavity below the gum).
4. The inner enamel ring.
5. The cementum which may or may not show a central canal.

Below the level of the infundibulum in cross-section we find the following:

1. Cementum.
2. An enamel ring, continuous with the outer enamel ring above.
3. A ring of dentin.
4. Pulp cavity containing pulp which recedes concentrically by the deposition of dentin, a process controlled by the odontoblasts previously noted. The deciduous incisors are much smaller than the permanent ones, the infundibulum is shallow and nar-

row antero-posteriorly. The enamel rings are much thinner. The permanent incisors lie orally (toward mouth cavity proper) from the deciduous ones and hence the pressure against the deciduous teeth is on the lesser curvature and not behind tooth as in the cheek teeth or as illustrated in certain books. Here absorption takes place.

The term *cheek teeth* is used to include the "grinders" implanted in the maxilla and rami of the mandible. Normally there are six in each arch, or 24 in all. In veterinary literature the term "molar teeth" has been used in this sense incorrectly. We apply the term molar only to those teeth which have no deciduous homologue, i. e., the last three cheek teeth. The remaining ones are the premolars, the wolf tooth being the first, while the second, third, and fourth are molariform. The equidae are the only mammals which have the premolars larger than the molars. This is especially apparent in a surface view. Figures 8, 12, 13, 14, 15.

From the evolution of the teeth as found by a study of the ancestors of the horse we note the change from a short to a long crown, the increase in size and complexity to molariform of all the premolars, except the first or "wolf tooth," the gradual development of cementum, and the infolding, which resulted in infundibuli in the superior cheek teeth, [3], [4] and [5].

At about the middle of the known ancestry, the "wolf tooth" began to recede. Our count table No. 2 shows them present above in 90 of 166 arches, (See Figs. 27, 35, 39), while but 9 of 160 showed evidence below and those in very young heads only (See Fig. 3) [5], [6], [7], [8]. We found seven arches below with supernumerary molars. Since this study was made we have found one arch with a supernumerary above. (See Figs. 4, 5) [12], [13]. This condition must be considered abnormal and not the result of atavism as Kitt has suggested, since the known ancestors of the horse never had more than three molars. Briefly, the embryology of the teeth, [9], [10], [11], shows that the epithelium (entoderm) of the mouth dips outward forming first the dental groove, then the dental ridge, certain parts of which become differentiated and grow medially as inverted cups—the enamel organs. The mesenchyme becomes specialized under the enamel organ forming the odontoblasts and connective tissue of the pulp. Much later the alveolar periosteum follows the folds of the enamel organ to deposit the cementum. The dental ridge is said to push backward under the surface to form the enamel organs of the molars. For some unknown reason[9] a numerical variation occurs; in the mandible, four occasionally develop instead of three. *Our specimens of this supernumerary mandibular molar show it to develop in an*

*independent alveolus behind the third molar. Yet it is not correct to call it a fourth molar. Its pattern is that of the third molar and we believe it should be designated a supernumerary third molar.* The following specimens show the evolution of this tooth and its results:

Head No. 31, four years old, supernumerary third molar present on right side only, not erupted and one and one-half inches long. (Fig. 6.)

Head No. 12, seven years old, bilateral, teeth just coming into wear. (Figs. 7 and 8.)

Head No. 29, donated to me by Dr. O'Gorman of Anton, Iowa, Bilateral. No history; but, judging from mandible from which fifth tooth on the right side is gone it must have been a surgical case. The sixth cheek tooth (3d molar) on either side was very loose in the alveolus, while the supernumerary was solid. (Figs. 8 and 9.)

Head No. 30, dissection No. 112, Bilateral supernumerary third molar. The sixth mandibular cheek teeth on both sides loose, the supernumeraries solid and both very long, the left having perforated the soft palate into the pharynx. (Figs. 10 and 11.)

The following table No. 2, shows the numerical findings from 83 superior arcades and 80 lower arcades from all breeds, ages, and sexes. (Canines not included, see the quotation following table No. 2.)

TABLE NO. 2.

| Upper Jaw (One side) | Incisors | $P^1$—Present (wolf tooth) | $P^1$—Absent (wolf tooth) | Cheek Teeth |
|---|---|---|---|---|
| 166 | Normal No. (B) | 90 (x) | 76 | Normal No. (A) |

| Lower Jaw (One side) | Incisors | $P_1$—Present (wolf teeth) | $P_1$—Absent wolf teeth | Cheek Teeth | Abnormal. |
|---|---|---|---|---|---|
| 160 | Normal No. (B) | 9 (y) | 15 | Normal No. 153 | 7 (z) |

Sisson says that "Ellenberger found, as a result of extensive observations (8000 subjects) that 2 or 3 per cent of mares have erupted canines in both jaws; that 6 to 7 per cent have them in upper jaw; while 20 to 30 per cent have them in the

lower jaw." He further states that "In the mare the canines usually are very small and do not erupt."

B: See Figs. 44 and 45 for which I am indebted to Dr. Bemis and his associates of the clinical staff of this school; both cases show supernumerary incisors, Fig. 44 also shows a retained deciduous tooth [24, 25, 26, 27].

A: See Figs 4 and 5 found after this study had been made.

x: Mostly bilateral. (See Figs. 27, 35, 39.)

y: Bilateral in 3 heads, unilateral in 3 heads. (Fig. 3.)

z: 3 heads bilateral, 1 unilateral. The supernumerary molar was posterior to the third. Two of these heads were in the 46 recent specimens, one in sixty dissecting room specimens, and one donated to me by Dr. O'Gorman of Anton, Iowa. Assuming that we had overlooked none in the dissecting room, the ratio would then be present 7, absent 273 or in per cent 2.5 per cent of the single rami of mandibles. Again in 4 heads of an actual 80, equals 5 per cent, of 140, 2.8 per cent; *the presence of supernumerary mandibular molars is common enough to be noted of the previously recorded cases, all were bilateral,* I believe except Sheppards[17]. I have also seen three cases on exhibition in a museum and since writing this have been informed that Prof. Williams has some specimens in his collection [13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23]. In my opinion, the mandibular teeth are the simplest in structure and may be explained by imagining them to be inverted blind sacs of enamel lined by dentin and covered by cementum. From the lingual surface we have two lateral outfoldings which branch anteriarly and posteriorly thus forming T's of the contained cementum. The stem of the anterior one reaches the anterior contact surface, while the posterior one is just behind the middle. Between these two surrounded by enamel is a T of dentin, with the base laterally, opposite which is a slight indipping of enamel from the buccal surface. (Figs. 3 and 8.) Except the first and last which are triangular they are quadrilateral on the masticatory surface, longer anterioposteriorly than transversely. They show a groove on the lingual surface.

The superior cheek teeth develop in much the same manner except that the folding of enamel has been constricted off to form infundibuli, so that in a cross section of a worn tooth (See first molar Fig. 13) we find an outer shell of cementum, an irregular ring of enamel, the two plates of dentin, two irregular crescent-shaped rings of enamel (infundibuli) filled with cementum. There is a slight lingual ridge while the buccal surface presents anterior and middle prominent ridges, and a low posterior one. Thus are formed two grooves, the anterior of which is the deeper. The lingual surface presents a

column or ridge. It shows a T shaped mass of dentin with the base toward the anterior infundibulum. Both the superior and inferior cheek teeth shows five subdivisions of the pulp cavity. The position of these may be determined by the black lines on the masticatory surface which marks the union of the plates of dentin (In some cases the dentinal plates fail to fuse, the pulp cavity is thus left open.) (See Figs. 13 and 14.) *It should be noted that the pulp cavity extends into the functional crown just above the level of the gums.* The foldings of the enamel increase the amount of hard wearing surface. The enamel is supported on one side by cementum, on the other by dentin. Both substances are softer than enamel so the surface of enamel is always evident. On account of the fact that the mandibular teeth are nearer together than the superior cheek teeth, they are higher medially on the masticatory surface while the reverse is true of the superior ones. The teeth are not rigid in the alveoli but can move to a limited extent which probably accounts for the fact that the enamel is thin or even absent on one tooth at the contact surface, since the obliquity would cause them to be pushed against the adjacent one in mastication. Ostertag says, (Beyer and Frohners surgery) that "the most common inherited structural anomoly of the teeth of the horse is the partial cement defect." While a capillary canal within the cementum of the infundibulum is frequently present, larger ones are hardly normal. The following study (Table No. 3) of 100 adult superior arches shows the fourth and fifth to be most commonly deficient at this point (Fig. 16), probably on account of the fact that their movement forward and quick eruption after leaving the level of the bone has prevented complete cementation, and later the nutrition is evidently not so good on account of passing under the plate separating the two parts of the maxillary sinus, and the lateral migration of the roots. (See Figs. 12, 14, 15, 16 and 1.)

Normal 52. Defective 48.

TABLE NO. 3.

| No. of Arches. | | No. of Arches. |
|---|---|---|
| 1 | First only defective | 1 |
| 0 | Second only defective | 0 |
| 1 | Third only defective | 1 |
| 12 | Fourth only defective | 12 |
| 15 | Fifth only defective | 15 |
| 0 | Sixth only defective | 0 |
| 1 | First and fourth defective | 1 |
| 6 | First, fourth and fifth defective | 6 |
| 11 | Fourth and fifth defective | 11 |
| 5 | Fifth and sixth defective | 5 |
| 6 | All defective | 6 |

Total defects for the individual teeth compared to total number examined:

| | |
|---|---|
| The First | 14% |
| The Second | 6% |
| The Third | 7% |
| The Fourth | 34% |
| The Fifth | 33% |
| The Sixth | 11% |

The paranasal sinuses are air spaces in the bones of the face. They may be considered diverticula of the nasal cavity since their lining mucous membrane is continuous with that of the middle meatus. The frontal sinus is bounded above and laterally by the frontal, nasal, and lacrimal bones, below by the frontal, lamina lateralis of the ethmoid, and the posterior part of the superior turbinal. The posterior or frontal portion is bounded medially by a septum common to the right and left sinuses, while the anterior or turbinal portion is bounded by the superior turbinate bone. The wall between the sinus and nasal cavity from within the sinus to nasal cavity (common meatus or dorsal part of middle meatus) consists of the following: 1. A thin mucous membrane. 2. A thin plate of bone. 3. A thick highly vascular mucous membrane. This sinus communicates indirectly with the middle meatus thru the posterior compartment of the maxillary sinus. The opening is oval, one to one and one-half inches wide, and two to two and one-half inches long, and is located in a horizontal plane thru the medial canthi and lacrimal canal about parallel with the facial crest, while a transverse plane thru the medial canthi would bisect the long axis. It should be noted here again that the bony lacrimal canal forms the anterolateral boundary of this opening. Topographically the posterior limit of the sinus in the young head is a transverse plane just behind the supra-orbital process, in the old head a little further back. Anteriorly Sisson gives a transverse plane half way between orbit and end of facial crest. A more accurate boundary is determined by passing the thumb and finger backward astride the dorso-lateral aspect of nasal bones until they diverge. (Figs. 17 and 18.) There is usually a rounded elevation or prominence on the dorsal aspect of nasal bones at this point also. The anterior extent then, is usually in front of Sisson's boundary. With the head in normal position (i. e. oblique) the anterior turbinal part has no natural drainage.

The maxillary sinus is bounded laterally by the lacrimal, malar and maxillary bones, ventrally by the maxilla (alveolar plate) but in part also by the posterior part of the inferior turbinate (Fig. 108.) Medially it is bounded by the maxilla and inferior turbinate. The floor is very irregular and constantly

changing due to the development and extrusion of the teeth. This boundary will be noted with the individual heads in the tabular description of the fourth and fifth cheek teeth. Table I.) The anterior boundary topographically is a line drawn from the anterior end of the facial crest to the infraorbital foramen. The dorsal boundary then, is a line drawn from this foramen to the inner canthus of the eye. *This line also gives the upper danger line,* since it is practically the line of the bony lacrimal canal which in front is usually just at the upper margin of the infraorbital foramen (in rare cases it is medial to upper part of foramen), and like the infraorbital canal is slightly convex dorsally. (Fig. 35.)

The sinus is divided into two parts, an anterior and posterior compartment, by a bony plate. Sisson gives the average location of this as being two inches posterior to the anterior end of facial crest, thence upward, backward and inward. In our young heads it is nearly vertical and above the fourth cheek tooth, in the older heads it is usually opposite the fifth, or between that and the sixth. It is vertical and transverse for about one inch, then, bends backward and the plate extends obliquely inward, upward and backward. *It is noted later that the plate may be lateral to, in front of, or behind the fifth tooth.* It is said always to be absent in the mule. In our limited observations of this hybrid it has been absent. In young heads it (the bony partition) is frequently absent, rarely in old heads, although the bony plate is frequently defective, especially above in the turbinal portion, but the defect is covered by mucous membrane in the majority of cases. Our dissection records of sixty subjects show only four marked variations. In two, the septum came forward to the anterior end of facial crest, in another the anterior compartment was subdivided laterally showing a separate compartment, which is not uncommon according to Williams of Cornell. In the fourth case the mucous membrane in the upper part of the septum was perforated by a circular opening one inch in diameter. In one sculptured head the anterior limit of the sinus was a transverse plane one inch behind the anterior end of facial crest (Fig. 30). The septum here between the anterior and posterior compartments was approximately one inch anterior to orbit, the fifth tooth was projected into the anterior compartment.

In the new born foal the sinus is very small, the second cheek tooth is below both infraorbital foramen and anterior end of facial crest. The fourth cheek tooth (first molar) is developing just under the anterior part of orbit. It is now 1.5 cm. long. (Fig. 19.)

The facial bones, especially the maxillae, develop rapidly, the anterior end of the facial crest is above the central ridge of the second cheek tooth. (See table for older heads.) The following table No. I, and explanatory notes show some of the changes of the teeth, and give some indication of the development of the face compared to the rest of the head, showing in a striking manner that the length of the face increases faster than the remainder of the head. This is principally due to the growth of the maxillae, although the premaxilla also adds a considerable amount. While the most of this furnishes space for the developing teeth, the interdental space grows rapidly up to two years.

## TABLE I

| Age | Length of head | Nuchal crest to ant. margin of orbit | Orbit to labial surface of incisors ($I^1$) | Ant. End of Facial Crest Above (d) | Length of facial crest in front of orbit | Extent of table surface of teeth in use | Description of Fourth Cheek Tooth ($M^1$) | Description of Fifth Cheek Tooth ($M^2$) |
|---|---|---|---|---|---|---|---|---|
| 6 mo.---- Fig. 20, 21 & 22 | 53 cm. | 23 cm. | 30 cm. | Union of 2d and 3d cheek teeth-- | 8 cm. | 11½ cm. | Anterior to orbit. 5 cm. long. | Under Orbit. 1 cm. long. |
| 15 mo. (y) Fig. 23, 24 & 25 | 56 cm. | 24 cm. | 32 cm. | Middle ridge of third cheek tooth ---------- | 9 cm. | 13½ cm. | Erupted and 1½ cm. posterior to anterior end of facial crest. 8½ cm. long. | Separated from fourth by thin plate. Slightly under orbit. Mostly anterior. 7 cm. long. |
| 2 yr. (z) Fig. 26, 27 & 28 | 67 cm. | 29 cm. | 38 cm. | Middle ridge of third C. T.------ | 10½ cm. | 18½ cm. | Location same as above. 10½ cm. long; roots forming becoming oblique. | 1½ cm. anterior to inner canthus. 10½ cm. long. Very thin interalveolar plate between it and the fourth. |
| 2½ yr.---- | 67 cm. | 28 cm. | 39 cm. | Posterior groove of third C. T.-- | 12 cm. | 17½ cm. | | |
| 3 yr.----- | 63 cm. | 26 cm. | 37 cm. | Posterior ridge of third C. T.------ | 10½ cm. | 20 cm. | | |
| 3½ yr. (A) Fig. 29, 30 & 31 | 60 cm. | 25 cm. | 35 cm. | Posterior ridge of third C. T.------ | 11 cm. | 18¼ cm. | Alveolar plate dropped enough to form the vertical plate below infraorbital canal. 1 cm. posterior to anterior end of facial crest. Roots 1 cm. long. Total length 9 cm. | Roots forming. Still very close to 4th. 9.8 cm. long. Superior extent of alveolar plate is on level with lower part of infraorbital canal. |

TABLE I—Continued

| Age | Length of Head | Nuchal crest to ant. margin of orbit | Orbit to labial surface of incisors (1¹) | Ant. End of Facial Crest Above (d) | Length of facial crest in front of orbit | Extent of table surface of teeth in use | Description of Fourth Cheek Tooth ($M^1$) | Description of Fifth Cheek Tooth ($M^2$) |
|---|---|---|---|---|---|---|---|---|
| 5 yr. (B) Fig. 1 & 2 | 66 cm. | 27 cm. | 39 cm. | Anterior ridge of fourth C. T.---- | 12 cm. | 20 cm. | It lies under the anterior part of facial crest 2 cm. below infraorbital canal 3½ cm. above lower part facial crest in anterior part of maxillary sinus. | It is 4½ to 5½ cm. anterior to anterior margin of orbit. Also about 3½ cm. above facial crest but only 1 cm. below infraorbital canal. May be under septum between two parts of sinus or in either compartment. |
| 6 yr. (B) Fig. 32, 33 & 34 | 65 cm. | 27 cm. | 38 cm. | Anterior ridge of fourth C. T.---- | 11¼ cm. | 20 cm. | | |
| 8 yr. 2 mo. (C) Fig. 35, 36 & 37 | 68 cm. | 28 cm. | 40 cm. | Anterior ridge of fourth C. T.---- | 13 cm. | 20½ cm. | The tooth has receded so that it is now 1 cm. above facial crest. | 1½ cm. above facial crest. |
| 12 yr.---- Fig. 38, 39 & 40 | 68 cm. | 27 cm. | 41 cm. | Anterior ridge (X) of fourth C. T. ---------- | 11½ cm. | 19½ cm. | Same as above (account of root development). | Same as above (account of root development). |
| 20 yr.---- Fig. 41, 42 & 43 | 68 cm. | 25 cm. | 36 cm. | Anterior ridge of fourth C. T.---- | 11¼ cm. | 17½ cm. | Approximately level with facial crest. | Level with facial crest. |

X—One head middle ridge of third. The table shows the anterior ridge of fourth as the rule for adult heads.
(d)—Two or more heads were examined for each age for this particular data.
C. T.—Cheek tooth.

The reader is referred to a table of eruption given by Sisson & Chubb[5].

(y) The sixth cheek tooth (3d molar) beginning to develop at 15 months. All have started except the third mandibular tooth below which is only 4 cm. long at two years.

(z) *All of the heads from two years on are from large draft horses except the 20 year old.* Sixth tooth 3⅛ cm. long lies under middle of orbit and is very oblique. It might be noted that the second cheek tooth has now reached its maximum height and lies just under and anterior to the infraorbital foramen, a position kept until six or even eight years. In the latter case it has dropped (extruded) 1 cm. It should be noted in removing the external plate of the maxilla from this and the anterior one that the infraorbital nerve lies lateral to the teeth except in very old horses.

(A) It should be noted here that the third, fourth and fifth are separated from each other only by very thin interalveolar plates, while the roots of the first and second are almost 2 cm. apart, the second and third are one centimeter, the fifth and sixth a trifle more than two cm. The first cheek tooth is vertical or directed slightly backward, while all of the rest slope downward and forward in terms of a transverse plane, *and all slope downward and outward in a sagittal plane.* It should be noted that the buccal ridges are convex, the convexity being directed forward. The obliquity and curvature is most marked on the sixth which is now 9½ cm. long with its proximal end on a level with the ventral margin of the anterior half of orbit, also directly ventral and slightly lateral to the first portion of the infraorbital canal, a position maintained until after six years of age, when it begins to recede. From eight to twelve, it remains approximately 2 cm. ventral to the canal on account of development of roots. From twelve years on the recession is constant. The tooth after six years is well under the frontomaxillary opening and after eight years is far enough below the infraorbital canal to be safely operable through both sinuses[28]; although the long axis would allow the procedure even at three and one-half to four years, if the opening in the frontal sinus were made far enough posteriorly to be parallel to the long axis of the tooth.

(B) A most remarkable change is noted here, *the separation of imbedded parts of all the teeth*, due probably to two factors; first, the growth of the sixth tooth which has a tendency to push the teeth forward at the functional crown, second, the development of spongy bone between the two compact plates of the inter-alveolar plate or septa. The third and fourth as well as the fourth and fifth are 1 cm. apart at the roots, the fifth and sixth

are still 2 cm., the second and third 1 cm. The first and second are closer now, the distance being approximately 1 cm. There is another change apparent at this time, the width between the anterior ends of the right and left facial crests has increased, *the transverse distance between the roots of the fourth and fifth of opposite sides has greatly increased in terms of the infraorbital canal* (which is approximately a sagittal plane). *The roots have shifted laterally one-half the diameter of the tooth* so that now all of the alveolar plate is visible, and the medial part of the alveolar plate is bent upward to form the plate of bone extending ventrally from the infraorbital canal as previously described. The explanation for this lateral shifting probably lies in the following facts: The sinus is lateral to the teeth, the bone is most resistant at the alveolar border (fulcrum here). In mastication on a particular side, the mandible is shifted to that side, while the mouth is opening, then as the mandible is raised, (mouth closed) the mandible moves toward the median plane. This (power) then would tend to push the crown of the maxillary teeth medially and the roots laterally. We have previously noted that the crowns of the cheek teeth make a slight curvature longitudinally with the convexity lateral, we can now note that this is also true of the imbedded portions, and markedly increasing up to 8 years.

The first, second and third cheek teeth always slope downward and outward in terms of a sagittal plane. *The fourth downward and outward until five years, then it becomes vertical at six or seven and slopes downward and inward at eight. From this time its roots are farther lateral than any other portion of the cheek teeth. The fifth does likewise about one year later.* While the root of the sixth moves laterally also, it may or may not reach the vertical. If it does it is only in old age. This of course does not mean that the masticatory surfaces of right and left sides approximate, since the inclination of this surface, with the mandibular teeth nearer and having the opposite inclination would tend to separate them in a simple up and down movement, which actually seems to take place with advancing age. We hope to study this latter phase of the problem further at a future time.

(C) The enlargement of the cavity of the sinus has been gradual on account of the development of both the reserve crowns and roots of the teeth up to this time. The recession of the alveolar part (plates) of the maxilla allows a constant increase in size of the sinus. The development of the roots still continues but the rate of growth is much slower.

The facial crest is nearly straight in the young head, later a pronounced downward curve of the anterior end is evident. The anterior end of the facial crest measured from its lower

aspect to the alveolar border is 3.5 cm., the variation is usually between 3 and 4 cm., although in some old subjects it may be only 1.5 cm. (Fig. 42.) The facial crest is not parallel with the masticatory surface of the teeth, it is a little higher posteriorly.

Even in young heads the sinus is lateral to the teeth. The infraorbital canal not only partially divides the anterior compartment but also the posterior one. The posterior one communicates with the frontal sinus through the frontomaxillary opening previously described. It also communicates posteriorly and medially at the lowest point with the sphenopalatine sinus over the infraorbital canal under the lateral mass of the ethmoid. Just under and anterio-medial to the fronto-maxillary opening, over the posterior part of the inferior turbinate and under the superior turbinate it communicates with the middle meatus nasi by a very narrow slit, which marks practically the highest point of the sinus, *hence no natural drainage.*

The anterior compartment is in communication with the middle meatus just anterior to the slit described above, it is over the dorsal part of the ventral turbinate, *hence no natural drainage.* The infraorbital and bony lacrimal canals should be again noted as well as the palatine vessels and the two portions of the anterior compartment of the maxillary sinus.

At this time it gives me great pleasure to acknowledge my indebtedness to my colleagues of the Veterinary faculty for their unselfish aid in the collection of the material that made this study possible; also to the aid of all past and present student assistants especially Mr. G. W. McNutt for help in preparing the specimens.

The photographs for the figures used in publication have been made by Prof. F. E. Colburn, College Photographer, to whose skill and carefulness we are much indebted.

For the following bibliography we make no claims to completeness. We should appreciate very much other references to work which we have overlooked. We would also be glad to examine specimens brought to our notice.

1—Sisson, Septimus. The Anatomy of the Domestic Animals. 2nd Ed. 1914, pp. 396-403, illus.

2—Meek, Alexander. Post Embryonal Development Approached From a Statistical Study of the Incisor Teeth of the Horse. The Veterinarian, LXX, pp. 391-400, 437-449, 1897.

3—Osborn, Henry Fairfield. Evolution of the Mammalian Molar Teeth. New York, Macmillan, 1907, illus.

4—Mathew, W. D. Evolution of the Horse in Nature. Publications of the American Museum of Natural History.

5—Chubbs, S. H. The Horse Under Domestication. Its Origin and the Structure and Growth of the Teeth. Publications of the American Museum of Natural History.

6—Ellis, Robert W. Veterinary Dentistry. Am. Vet. Rev. XXVII, pp. 43-98, 1903-1904.

7—Flower, William Henry. The Horse; a study in natural history. New York, Appleton, 1892, pp. 114-141.

8—Bradley, O. Charnock. Another Dental Anomaly in the Horse. Vet. Journ., London, New Series XII, 188-190, 1905, pub. II. Sept.

9—Keibel & Mall. Human Embryology.

10—Stohr's Histology (Lewis).

11—Bonnet, Entwickelungsgeschichte.

12—Bradley, O. Charnock. On Two Cases of Dental Anomaly. Jr. Anat. and Phys. XXXVI, 1902, p. 356.

13—Bradley, O. Charnock. On Variation in the Number and Form of the Premolars and Molars of the Horse. Vet. Journ. London, New Series XII, 244-253, 1905, pub. I. May.

14—Axe, Prof. J. Worthley. The Horse: Its Treatment in Health and Disease. Vol. II, page 326, illustration of supernumerary Mandibular Tooth.

15—Bradley, O. Charnock. Two Cases of Supernumerary Molars with Remarks on the Form of the Lower Cheek Teeth of the Horse. Anatom. Anzeiger Bd. 24, 1903.

16—Denslow, I. S. Abnormal Dentition. Am. Vet. Rev. VI, 390-391, 1882.

17—Shepard, E. H. Equine Dentistry. Am. Vet. Rev. XVI, pp. 249-256, 1892.

18—Clarke, William H. Horses' Teeth. 4th ed. N. Y. Jenkins, 1912 (c 1893), 308 p. illus.

19—Goubaux & Barrier. The Exterior of the Horse. Translation of Harger.

20—Moller & Dollar. Regional Veterinary Surgery.

21—Bayer-Frohner. Handbuch der Tierartzischun Chirurgie und Geburtshilfe, Band III, Teil I, p. 322 et seq.

22—Veith, A. Contribution to the study of the dentition of the Equidae. Arch. Naturgesch 78, Abt. A. No. 5, pp. 1-33, 1912.

23—Colyer, J. F. Variations and Diseases of the Teeth of Horses. Vet. Rec. Lond., XVIII, 828-831, 1905-6.

24—McCullough, C. The Teeth of the Horse as Affected by Age. Structure and development and irregularities of Teeth. Virginia Sta. Bul., 115 to 120 incl.

25—Pupas, Leon. Irregular Dentition by Union of the Right Middle Incisor with a Supernumerary Tooth. Vet. Journ. London, New Series IX, p. 210, 1904.

26—Hoare, E. Wallis. Irregular Dentition in Horses. Vet. Journ. XXXVI, p. 88, 1893.

27—Macgillivray, A. E. Abnormal Dentition. Vet. Journ. XIV, 238-239, 1882.

28—Bemis, H. E. Repulsion of Third Molar, in report of Committee on Surgery, Iowa State Vet. Association, 1912.

# Diseases of the Head of the Horse

H. E. BEMIS, AMES, IOWA.

We are all aware that a full discussion of the diseases of the horse's head would require much more time than is allotted to this subject upon our program. I have, therefore, chosen to speak of the more common affections of the teeth, sinuses and nasal cavities.

Ostertag classifies the diseases of the teeth as follows:

I. Diseases of the Whole Tooth and the Hard Substances.
   A. Congenital abnormalities in size and form.
      1. Anomalies, such as absence of one or more teeth, increased number of teeth, and teratoid growths or inclusions resulting from faulty development in the embryo.
      2. Faulty position of teeth, as the faulty position of one tooth or of a group of teeth (prognathia and brachy gnathia), or too great separation of right and left rami of the mandible.
      3. Abnormalities of the structure of the tooth.
   B. Irregularities in the Eruption of Teeth.
   C. Irregularities in the Wear of Teeth.
   D. Diseases of the Tooth Proper.
      1. Fracture.
      2. Caries.
      3. Formation of tartar.

II. Diseases of the Pulp, Dental Periosteum and Gums.
   A. Pulpitis.
   B. Alveolar periostitis—aseptic, septic.
   C. Diseases of the Gums.
      1. Simple inflammation.
      2. Phlegmonous inflammation.
      3. Ulcerous inflammation.
      4. Tumors and cysts.

III. Diseases of the Maxilla and Mandible.
   A. Fractures.
   B. Inflammation in the neighborhood of the alveoli.
   C. Swelling of the mandible.
      1. Inflammations.
      2. Tumors.
      3. Cysts.
   D. Actinomycisis.

From this classification I will attempt to select those conditions from the various groups that to my mind are of the most practical importance. Concerning the irregularities in size, number, and placement of teeth, you have already had a most excellent lecture and demonstration by Dr. Murphey and some of the specimens before you will serve to show the pathological conditions resulting from these irregularities. For instance, the hard palate is shown to have been perforated by the super-

numerary lower third molar, a condition not uncommon in case of excess teeth or teeth out of position. See Fig. 11, also Figs. 4, 5, 6, 7, 8, 9 and 10.

The clinical symptoms and treatment of this group are practically identical with those of the groups "Irregularities in Wear," or alveolar periostitis as they lead either to the development of long teeth or to loosening of the gums followed by alveolar periostitis. Abnormalities in the development of teeth include true dental tumors or odontones in which there is an increase in the amount of some one or more of the hard substances of the tooth and teratoid tumors or cysts which may be present at birth or begin to develop during the first or second year of life. These teratoid tumors spring more commonly from the roots of the second or third premolars in young horses and continue to enlarge until they fill all neighboring cavities, cause enlargements of the face and encroach upon the hard palate. See Fig. 101.

The tumor tissue is very soft and easily broken down. The tumor and affected tooth should be removed completely as early as possible if any success is to be had. The animal should be anaesthetized, a trachea tube inserted and the affected parts

Fig. 100—Cement-adontome involving the roots of the fourth mandibular cheek tooth of a seven-year-old mare.

Fig. 101—Cross section of head of nine months old colt in the region of the fifth cheek tooth showing an enormous follicular cyst, or congenital odontome.

Fig. 102—First and second upper cheek teeth removed from year old horse because of alveolar infection which had evidently gained entrance through cement defects in the infundibuli. Note discoloration of roots of tooth A and productive periostitis on roots of tooth B.

liberally trephined, cutting out the plate of bone between two trephine openings if necessary in order to remove the tumor thoroughly.

Under abnormalities in the structure of teeth, one defect deserves place above all others, that of lack of development of the cement which should fill the infundibulum. This defect seems to be the most common in the upper true molars particularly the first. Lacking this material, food particles, saliva and bacteria penetrate to the bottom of the cavity where they are separated from the pulp cavity only by the inner enamel and dentine. Investigations have shown that bacteria found under these conditions are almost invariably acid forming bacteria. As acids are the best decalcifiers, it is easy to understand how important this defect is as a cause of pulpitis, alveolar periostitis and fractures of the teeth. See also Figs. 14, 15 and 16.

Irregularities in replacement of teeth are probably more common in the incisor region where retained milk teeth sometimes force the permanent ones out of position. It is often difficult to distinguish between a retained milk tooth and an irregular permanent one by the differences in shape and color but it should be remembered that the milk tooth is always in front, the permanent behind. At times the deciduous premolars remain in position too long and may cause laceration of the cheeks or tongue or may delay the eruption of the permanent premolars until the gums become swollen and tender. Such retained teeth should be removed when injury is being inflicted.

Irregularities in the wear of teeth may result from the anatomical differences in the width and direction of the upper and lower arcades, from differences in the hardness of teeth within the same mouth, any interference with the act of mastication, such as inflammation of the tempero maxillary articulation, inflammation of the masseter; loose, misplaced or absent teeth, or diseases of the alveoli. The irregularities resulting are best described under the following headings:

Angular or sharp mouth.
Shear-like mouth.
Wave-formed mouth.
Step-formed mouth.
Premature wear.
Smooth mouth.

The diagnosis of these various forms can easily be made by a careful inspection and digital examination of the mouth, taken together with the history of the case and the general condition of the animal. Care must be taken not to join in the common opinion of the owner that the teeth are always at fault whenever there is lack of condition of the animal or evidence of improper digestion. The usual history is that the animal masti-

cates slowly, holds the head to one side, salivates and drops food back into the manger. When an animal is presented with such a history we must be sure that the local conditions uphold the history before proceeding to dress the mouth as similar symptoms may result from partial paralysis of the lips, cheeks, lower jaw, or pharynx, foreign bodies in the mouth, ulceration of the mucous membrane and many others. Moeller goes so far as to suggest that the necessity for dressing the teeth as a treatment for indigestion is often overworked but that the operation may aid digestion indirectly by throwing the animal off feed long enough for digestive disturbances to become corrected.

In regard to the usual treatment for these conditions, I would like to suggest three steps that seem to me to be of paramount importance:

First, enamel points should be removed in such a way as to avoid the possibility of breaking the attachment of the gums to the teeth or loosening the teeth of old horses.

Second, in cutting long molars remember that in many instances either in young or old horses, the pulp cavity extends above the line of the gums into the functional crown and may be exposed by excessive cutting. The only safe rule is to cut only what is necessary to prevent laceration.

Third, never overlook the importance of regulating the character of the food in those cases where premature or excessive wear is present.

Of the diseases of the tooth proper, fracture and caries are the most important in the horse. The formation of tartar does occur but is seldom harmful. Fractures of the first molar are the most common and those again of the upper jaw are more common than in the lower, probably for two main reasons, the congental cement defect in these teeth resulting in a cavity throughout the length of the tooth and because of the increased lateral pressure resulting from their position in the middle of the arcade. Many times the fracture is confined to the crown or a part of it and no farther injury results but commonly the fractured pieces become pushed out of line and injure the cheeks or tongue or open the alveolus. Extraction when necessary is usually not difficult.

Caries in the horse is not an important primary condition but when cavities exist as the result of fractures or cement defects, then caries unmistakably does exist and may break down dentin and enamel until the pulp cavity is exposed with the usual results. The process therefore usually starts on the wearing surface but is not recognized until some secondary condition is established. The treatment of caries in animals consists in extraction of the tooth which is often attended with difficulties because of its fragility.

Disease of the pulp and alveolar periostium can well be considered together as a primary pulpitis is rare in horses. Alveolar periostitis may be either acute septic or chronic ossifying (see fig. 102) the first form is however by far the more common and is often accompanied by the second. The chronic ossifying periostitis seldom exists alone.

A great variety of factors including many of the conditions already discussed are contributing causes of suppurtive alveolar periostitis. Among them are blows and contusions, extension of the inflammation from fracture of the bones, separation of the gums from the teeth by tartar, foreign bodies, careless dental operations, etc., faulty positions of teeth, supernumerary teeth, excessive cutting of the crown, cement defects, etc.

The cardinal symptoms of well developed cases of suppurative periostitis, cautious mastication, lack of condition, offensive and characteristic odor, loosening of the tooth, swelling of the bone and draining lymphatics make its recognition at this stage easy but in those cases of developing suppurative periostitis where the infection has entered in some obscure way, the diagnosis becomes more difficult. Many times a diffuse, edematous and painful swelling of the face over the roots of the premolars is the first indication of trouble. In some of these cases the infection enters through a break in the attachment of the gums, possibly left at the time of eruption of the permanent teeth or by the shedding of the deciduous ones, or it may enter through defects in the tooth itself. Retraction of the gums below the line of its attachment to the remaining healthy teeth should be regarded with great suspicion even though no odor can be detected.

One of the most frequent consequences of alveolar periostitis in the lower jaw is the formation of dental fistula while in the upper jaw, I am convinced that the condition often gives rise to inflammatory new growths which penetrate into the nasal cavity or sinuses or both causing great enlargement of the naso-maxillary region, with encroachment upon the nasal septum, maxillary sinus and hard palate. Most of these so-called tumors occur in young horses at from two to five years of age. We have operated upon a number in the clinic and find a tumor mass involving one or all of the cavities on the affected side of the head. Invariably these tumors spring from the maxilla in the region of the roots of the first four cheek teeth, more commonly the second or third. In this region the tissue is impregnated with calcarious material and the tooth when extracted shows some defect which has admitted infection into the alveolus but its exit not being easy the inflammatory new growth resulted from its presence. Many of the so-called odontomas in my opinion belong in this class.

The treatment of suppurative alveolar periostitis consists in extraction as soon as the condition can be diagnosed.

Fractures of the jaw fortunately are not very common. Their importance in connection with dental diseases are, first, that loosening of the teeth or opening of the alveoli may necessitate extraction and second, that great care is necessary in extracting or repelling teeth to avoid fracture.

Whenever, following dental operations, the wound refuses to heal it is first rate evidence either that some portion of the tooth or a bone sequestrum remains as a foreign body.

Inflammation of all three of the constituents of the bone, periosteum, bone tissue, and bone marrow may exist without injury to the teeth if the process does not become infected, though in young horses such injuries of either the upper or lower jaw in the region of the premolars may injure the roots or dental periosteum directly as they are often not covered by bone. Usually such injuries remain local but sometimes the inflammation involves the alveolus by continuity of tissue with a resulting dental fistula. In case of inflammatory swellings then of either the maxilla or mandible in the region of the roots of the teeth, the question arising is, what structures are involved? The swelling of ostitis or osteomyelitis is usually more diffuse, more sudden in its appearance, passive movements of the teeth of the region do not produce so marked pain as in case of alveolar periostitis. If a fistula develops the bone fistula is accompanied by greater thickening of the bone and involvement of the skin. the probe may be passed in several directions into cancellated tissue instead of striking upon the flinty hardness of the tooth. If there is still doubt as to whether the tooth is involved or not, more time should be taken to watch the course of the process. The tooth should be extracted only when involved. Bone fistulae usually yield to thorough drainage and curettement.

Tumors and cysts affecting the bones of the face and teeth are fortunately less common. Dermoid and dentigerous cysts are most commonly located at the base of the ear though occasionally they are found occupying the sinuses. They may contain from one to hundreds of teeth in all stages of development. The secret of success in their treatment is thorough removal of not only all teeth, but the bony cup or cupsule in which they are situated as well as the dermoid tract which exists in case there is a fistulous condition. Tumors are confined largely to osteomas osteo-sarcomas, and carcinomas. Osteomas occur along the lower border of the body and rami of the mandible, are firm, smooth, circumscribed, often pedunculated enlargements covered by the skin or mucous membrane which is not involved. If at all well circumscribed, they may be removed with saw or chisel. Sar-

Fig. 103—Showing tract in exposed tooth through which infection gained entrance to the alveolus and resulted in an inflammatory new growth which filled the sinuses and nasal cavity.

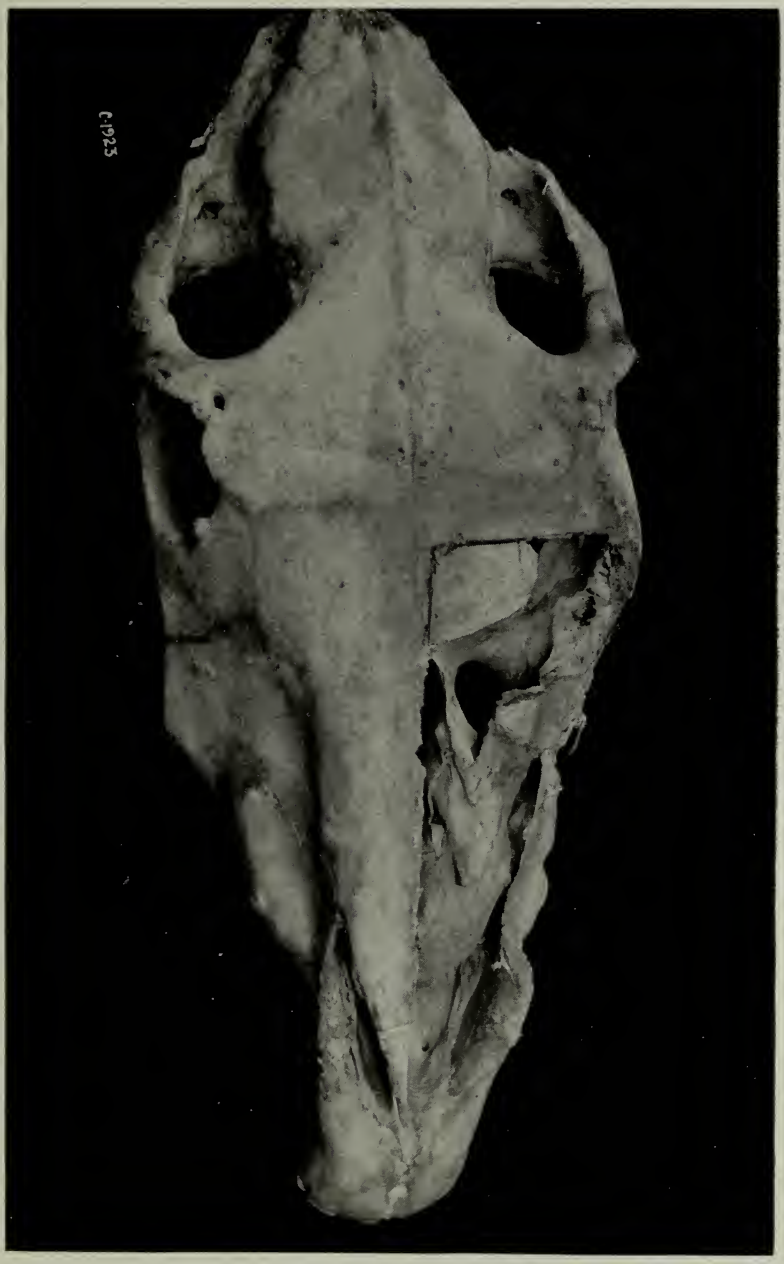


Fig. 104—Frontal view of Fig. No. 103 showing new growth in nasal cavity and sinuses.

coms and carcinomas usually involve the bone marrow and dental alveoli. They produce rapidly growing granular masses of soft tumor tissue, usually involve one or several alveoli, produce great interference with mastication, rapid emaciation and tumor cachexia.

The specimen before you is a carcinoma involving the fifth and sixth upper cheek teeth, gums and soft palate of a nine year old standard-bred stallion. After the appearance of the first symptoms, the tumor developed and spread rapidly by metastasis so that when killed two weeks later, the submaxillary glands, cervical and anterior pectoral lymphatics and lungs all showed involvement. Operative interference with such tumors is contraindicated.

Without going into details of technique in dental operations, I should like to suggest some methods which differ somewhat from statements in our text books of the present time. We all realize that extraction and repulsion of teeth is one of the most painful operations and yet both are performed all too often without anaesthesia. Recognizing that, one of the reasons for this practice is the fact that general anaesthesia is difficult to maintain when operating upon the mouth, the writer has recently employed nerve blocking by the injection of a local aneasthetic directly upon the maxillary or mandibular nerves at their points of entrance into the maxilla or mandible. For this purpose an ordinary hypodermic syringe equipped with a needle four inches in length is all that is necessary. The superior nerve can be reached by a puncture opposite the middle of the lower border of the orbital cavity and about one inch from it. The inferior nerve can be reached by a puncture forward from the posterior border of the mandible along its inner surface. Four cc. of a five per cent solution of cocaine or alypin will anesthetize the entire half of the maxilla or mandible including the mucosa. While injecting, the needle should be moved back and forth slightly to distribute the fluid. After a period of ten to twenty minutes, the operation can be performed with little or no pain. In our first case, an extraction of the first upper cheek tooth had been started without anaesthesia, with the usual signs of great pain, violent struggling, flinching and sweating. The operation was then abandoned until an injection of the maxillary nerve had been made, after which the first two cheek teeth were extracted with no more struggling than is usual under confinement and by the time the operation was completed the perspiration had dried off instead of increasing. Specimens shown in figures 100 and 102 were respectively punched and extracted under local anaesthesia.

Concerning the extraction of teeth, I am convinced that one of the most important considerations is an accurate diagnosis.

A tooth should be extracted only when diseased and when so affected they are comparatively easily extracted except in those cases where there has been a productive periostitis. Having determined upon extraction, thorough control of the patient in harness or upon the table under local or general anaesthesia will eliminate many of the accidents which have heretofore made necessary the removal of the external plate of bone or trephining followed by repulsion. Removal of the external plate can not be accomplished without serious damage to overlying structures. The extracting forceps should be notched and crossnotched on the bearing surface instead of being grooved so as to insure a firm hold upon the tooth without so much pressure as to crush it. The tooth should be well loosened by gentle lateral movements of the forceps before extraction is attempted. We do not agree with Moeller however, who states that only the upper premolars and first two molars can be removed by punching.

The third upper molar is the most difficult to repell because of the backward deviation of its roots carrying them back under the orbit and forward toward the median plane so that it can not be reached from the maxillary sinus, though with a special curved punch we have repelled this tooth on several occasions through a trephine opening in the frontal sinus at a level with the inner canthus of the eye and about one and one-half inches from the median plane. From this position the punch is passed through the communication between the frontal and maxillary sinuses and drops more directly upon the roots of the tooth especially so in old horses. For safe and easy repulsion the punch must always be placed upon the end of the tooth and in line with it. To repell the sixth lower cheek tooth choose a point on the most prominent border of the ramus of the mandible, make an incision two and one-half inches long through the skin and masseter muscle in the direction of the long axis of the tooth, and insert a small trephine or drill which should be held nearly parallel with the bone and start to trephine at a point about two inches to three inches from the border of the mandible. The plate of bone is thin below the roots of the teeth and care must be taken not to trephine or punch through it into the internal pterygoid muscle. The roots of the 2nd lower molar will be found in young horses almost upon the lower border of the jaw about 2½ inches in front of the point chosen for the third or just behind the inferior maxillary vessels under the anterior border of the masseter muscle.

The roots of the 1st molar and of the three premolars deviate only slightly from a straight line with their crown so they are more easily located. The trephine opening for all of these teeth in young or old horses should be made upon the lower border of the mandible. If fistulous openings are already present along

Fig. 106—Showing needle (A) in position for injection of superior dental nerve and (B) for injection of inferior dental nerve.

Fig. 107—Cross section of head through center of orbit showing superior dental nerve (N) facial process of molar bone (M) and course of needle indicated by line. Note that needle must pass some distance below the border of the facial crest to avoid contact with molar bone above point (X). The transverse facial vessels can be avoided by palpation from the exterior.

the side of the bone do not use them but make a new opening below so that the punch will be in line with the tooth. After the trephining has been completed, a probe should be passed through the opening until it comes in contact with the hard dental substance which can easily be distinguished in this way from the bone. Being sure that the opening is rightly placed, the punch can then be seated upon the tooth and repulsion effected with the least amount of injury to surrounding tissue.

Time will not permit of a discussion of the diseases of the sinuses and nasal cavities but I should like to draw attention to one or two points in the technique for supplying drainage from the sinuses. I believe that the frontal sinus can be most rationally and completely drained toward the outside instead of through the superior turbinal bone as is described in some of our best texts. An unvarying landmark for the lowest point in the frontal sinus is the point at which the fingers begin to deviate from one another when made to grasp the nasal bone and pass from below upward. (See Figs. 17, 18 and 40.) At this point trephine the nasal bone about 1½ inches from the median line, keeping above a line drawn from the inner canthus of the eye to ½ inch above the infraorbital foramen in order ta avoid injury to the osseous lacrymal canal. This opening will provide drainage for the frontal sinus from practically the lowest point without inflicting injury to the turbinal bone with the resulting disagreeable hemorrhage and danger of necrosis.

The inferior compartment of the maxillary sinus, formerly called the inferior maxillary sinus, is partially divided into an inner and an outer compartment by the passage of the infraorbital canal. (Fig. 36.) After trephining the outer compartment at the usual point on a line drawn perpendicular to the end of the zygomatic crest, a little higher or lower depending upon whether the animal is young or old, the internal compartment may be drained to the outside, except in young horses, by breaking down the plate of bone which supports the infraorbital canal, again avoiding the necessity of breaking through the inferior turbinal bone.

In closing I wish to acknowledge the many helpful suggestions of my colleague Dr. Murphey, as well as the work of our student assistants in the preparation of specimens and of our college photographer, Prof. F. E. Colburn.

## DISCUSSION.

It was my idea also to give the technique for the removal of the nasal septum. Our experience here shows the necessity of

removing the nasal septum at times in case of inflammatory processes which result in obstruction to the passage of air.

For the removal of the nasal septum I choose again for a landmark this same region which marks the lower limit of the frontal sinus, because that brings me to a point directly opposite the posterior nares, or the opening which I think is the most posterior point at which it is possible to remove the nasal septum, or at which it is necessary to remove it. See Fig. 18 at level of arrow.

Choosing this for a landmark, trephine exactly upon the median line, in spite of the fact that one may wound the turbinated bone and the artery beneath the mucous membrane. Trephine in two places, putting the two openings a distance of about two inches apart. Then with the bone chisel remove the bone between the trephine openings in order to get a chance to work at an angle so as to give a swing to the instruments, the chisel and scissors, which are necessary to remove the septum. Having made trephine openings and cut out the plate of bone between the two, and having controlled the hemorrhage, next dilate the nostril and cut the septum transversely below, leaving enough support at the end of the nose to support the nostril so it will not collapse. Having divided the septum at this point I next divide the septum transversely through the trephine opening across to the posterior border of the palatine bone. Then having cut the septum transversely in front and behind, introduce a double-guarded chisel—that is a chisel with a cutting surface between two blunt points. Push it backward along the inner face of the nasal bone until it appears below the trephine opening, then quickly place it in the same position below and push it backward until it cuts the nasal septum from its lower attachment. Having then completely isolated the nasal septum it may be removed through the nasal cavity or through the trephine opening. Possibly in some cases it may be necessary to divide it into two or three pieces in order to get it out of the small opening.

In this way we have removed several septums and with quite satisfactory results. It seems to me it is an operation that is comparatively easily and quickly done after you have made the trephine openings and removed the plate of bone. My attempt always is to do everything possible before I start operating on the septum itself.

There are probably many other points. I have gone over this subject very rapidly. If there are any questions I will try to answer them.

Question: Do you insert the tracheatomy tube before operating?

Dr. Bemis: I do in some cases, especially if there is much obstruction in breathing before operating. I think we should be guided somewhat in this by the nature of the conditions. If there is a suppurative process where there is danger of inhalation of purulent material, then by all means we should insert the tracheal tube and attempt to pack the pharynx to prevent inhalation. But if the process is open, chronic inflammatory tissue with little or no suppuration, then I am not much afraid of bad results from inhalation.

Question: Was this operation done under anesthesia?

Dr. Bemis: Yes, it has been done here so far under general anesthesia, but I believe it might be done under a local anesthetic, the only trouble being that perhaps you would have to use quite a large amount of the anesthetic. But I think after making the trephine openings here we might pack the nasal cavity on both sides of the septum with cotton or gauze saturated with a local anesthetic and adrenalin chloride, and between the two you would get some local anesthesia and control the hemorrhage. I know we can paint the nasal septum with adrenalin chloride and it controls the hemorrhage considerably.

Question: I would like to ask the technique you used in removing these two teeth?

Dr. Bemis: Aside from the injection of a local anesthetic it was simply the usual technique of extraction.

Question: You did not remove that plate of bone?

Dr. Bemis: No. The teeth were loose enough that they could be moved slightly with the fingers, consequently they could be extracted with forceps.

Question: In case you were not able to extract these teeth, what technique would you use?

Dr. Bemis: Well, that is a question, and I do not know that I can state positively, but I believe that in a great majority of cases if these teeth needed to be removed they could be removed by extraction. If they are really diseased at the roots, the teeth may be removed by extraction if we have the animal thoroughly controlled and go at the operation carefully. Having the animal anesthetized you can take more time to thoroughly loosen the teeth without putting enough force on the forceps to crush them or break them off. I believe with careful dental operation we can extract more teeth than we have heretofore, but I realize there are cases in which it is impossible to extract them. In that case then I probably would, in spite of the injury done to the overlying structures, follow Doctor Williams technique and remove the external plate of bone here, because that is the only way we can get at this on

account of the fact that the roots of the teeth are almost in line with infraorbital nerve. See Fig. 29. In order to do that Doctor Williams makes a transverse incision above the roots of the teeth, inserts a scalpel along the plate of bone and next to it until it comes out in the oral cavity at the attachment of the gums, and dissects the gums from the teeth. Then inserting a heavy retractor he pulls away the soft tissue and with a chisel or trephine goes through the plate of bone above the roots of the teeth, and then with the chisel cuts down on either side of the external plate until it is entirely loosened, after which it can be removed from the oral cavity and the entire tooth exposed as it is here. Following that a punch may be placed here, even though it is not directly in line with the tooth, and the tooth punched out. My opinion is that we should avoid that operation wherever possible.

# Mode of Action of Drugs with Pharmacological Demonstrations

H. D. BERGMAN, AMES, IA.

Gentlemen: It is not the idea in this lecture period to undertake a very exhaustive discussion of drug action, but merely to present some of the known facts regarding the nature of drug action in the body, to endeavor to explain the significance of the science of pharmacology, and to demonstrate by means of various apparatus, the ways in which the pharmacologist studies the physiological effect of drugs on the body organs.

It is the intention also, to take up a very brief discussion of two therapeutic agents, i. e. adrenalin and atropine, which are used largely by the practitioner, discussing them particularly from the standpoint of their influence on the heart and circulation, also demonstrate by means of various apparatus the influence of intravenous injections of these agents on certain organs of an anaesthetized experimental animal.

Disease accompanied by physical suffering seems to have been a natural inheritance of both man and animals, while curative methods and methods of alleviating pain are largely of man's own adaptation and creation. From the earliest biblical times the ills "that flesh is heir to" were recognized as a menace to life. In the development of modern medicine from the earliest dates to the present time, various ideas and methods have enjoyed periods of favor, but whether it was witchcraft, sorcery, faith, charms, hydropathy, venesection or drugs, the same inherent hope has prevailed at all times, i. e., to relieve and palliate physical suffering. Human thought however, is no longer so prone toward superstition, hence intelligence has allowed medical appliances and treatment to be developed into a systematic and logical science.

One of the achievements of the last half century has been the development of the study of the action of drugs along lines formerly unheard of. This has been brought about by methods analogous to those upon which the modern science of physiology is founded, i. e., by recourse to animal experimentation. Well directed research has replaced accidental observation to the extent that our knowledge has been placed upon a footing of exactness, without which, the application of drugs to the treatment of disease could only be empirical. The evergrowing importance of the science of pharmacology has revolutionized methods of teaching and studying. Discourses on the application of drugs to the cure of disease, must be supplemented by discourses on the physiological action of the drugs, on the

reasons for these actions, and on the experiments upon which the stated facts are based.

Pharmacology investigating as it does the changes in the physiological activities of normal living organisms as induced by chemical or physical-chemical agencies, is one of the most recent developments of medical and biological science. Only by animal experimentation can the actions of drugs be ascertained in detail and with exactness, and at the present time when a new remedy appears almost weekly, it is neither possible nor advisable to wait the verdicts of clinical evidence to separate the useful from the worthless, even if it were permissible to apply to the human subject or valuable lower animals, drugs of unknown action and potency. Both clinical and laboratory research are necessary to the complete knowledge of the action of a drug. From the earliest times attempts have been made to explain the effects of drugs on a basis of the then prevailing ideas of pathology, but the objective study of the action of drugs on the organism has been a comparatively recent development, brought about by adopting methods similar to those which have added so much to our knowledge of physiology.

## PHARMACOLOGICAL ACTION OF DRUGS VERSUS APPLIED THERAPEUTICS.

The question may be rightfully raised as to the comparative action of drugs on the normal individual and in pathological conditions. Pharmacological action has been described as a change induced in the normal physiological functions by drugs, while therapeutics as applied may be an effort to induce a change in pathological functions, with the object of aiding the recovery to normal. The question may be asked whether the examination of the effects of drugs in normal animals is of much value in indicating their therapeutic action. For example, the antipyretics reduce temperature in fever, but will not reduce temperature in health, the bromides will inhibit certain convulsions, but have much less effect in depressing the normal brain, or again, the practitioner has often observed the futile effect of large doses of sedatives in severe abdominal pain, as compared with the effect on a normal individual.

In answer it may be said that in a great number of instances drugs are given not to act particularly upon the diseased tissues, but upon healthy ones, for pathological changes in one organ causes changes in the interrelations of other body organs, hence in general functional co-ordinations. The object of the therapeutist is not usually to restore the diseased tissue, but to relieve it from work, and allow it to rest, so as to promote

its restoration by nature. Hence in many instances, it may be seen that drugs are given to act on normal tissues, or upon tissues so little affected by disease that they react to remedies in the same way as do normal tissues. It is to be admitted that in diseased conditions there are changes in the protoplasm itself, and pathological protoplasm will not always give the same quantitative responses to a drug as does the normal, and in fact, there may be certain qualitative variations as well. In general, however, the response is of similar quality, but varies more widely, quantitatively. It is very evident to the careful observer that familiarity with pharmacological action is a necessary foundation for proper therapeutic applications. However, the changes induced by the pathological conditions accompanying the disease must be taken into consideration, and corresponding variations shown in the quantitative or qualitative response to drugs in certain diseased conditions carefully noted.

Applied therapeutics may be subdivided into emperical and rational therapeutics. Emperical therapeutics often styled the therapeutics of experience, was the original method in the application of drugs, and has conferred many rich gifts upon medical science. The use of arsenic in anorexia and cachexia, the iodides in various paralyses, etc., are examples of emperical therapeutics. Permitted to reign supreme, emperical therapeutics would be destructive to all exactness in therapeutical progress. Rational therapeutics refers to the use of remedies based upon a knowledge of the pathological conditions present, and the physiological action of the agent employed. Albrecht von Haller, the father of physiology, was the real originator of modern physiological therapeutics, his dogma being that "drug proving is the only true basis of drug using." This idea is now inspiring the minds of medical men the world over, and the conviction that physiological experimentation with drugs, combined with clinical experimentation by the practitioner, is the proper basis of their therapeutic employment, is growing into a fixed law of professional belief.

## MODE OF ACTION OF DRUGS.

Drugs may affect organs and tissues of the body either directly or indirectly. They change directly only those organs and tissues with which they come into immediate contact. The alteration, however, of one part of the organism due to the direct action of a drug, often entails a change in another part or organ to which the drug may not have access, or has no special affinity. These changes are due to transmission of nervous impulses, or to changes induced in the circulation or nutrition.

As examples, the application of counter irritation over the thorax in congestions of the lungs directly or primarily produces irritation of the skin, but secondarily or indirectly relieves internal congestion by inducing reflex contraction of the subjacent blood vessels and thereby reduces the congestion; again, irritation of the skin may alter the pulse rate by reflected impulses from the cutaneous nerves affecting the inhibitory nerves of the heart; similarly a poison that weakens the heart may induce disordered respiration due to deficient circulation in the medulla and hence inhibition of normal activity of the inspiratory center; these secondary changes which are not due to the direct action of the drug on the organs concerned are known as indirect or remote effects.

The *local* action of a drug is that induced at the point of application before it enters the circulation; the *general* or systematic action is that due to its elective affinity for certain organs to which it is carried by the blood. Local effects may be induced wherever the drug can be applied; in the skin, the alimentary canal, the respiratory passages or other mucous membranes. They may cause irritation or protect from irritation, may depress the sensory end organs and thereby cause local anaesthesia, may lessen secretion, or alter the functions at the point of application in other ways. Many drugs have only a local action because they either are not absorbed, are absorbed in inactive forms, or are excreted or deposited as rapidly as they pass into the circulation, so that enough is not present in the blood at any one time to induce general effects.

It is evident that for a drug to exercise a general action it must enter the circulation, and the process by which the drug enters the circulation is spoken of as absorption. Rate of absorption varies in the different tissues, hence rapidity of action depends largely upon method of administration. It was at one time believed that drugs radiated from the seat of application throughout the system by the nerves, however, the fact that blood taken from any part of the body, far or near from the point of application contains the drug, also the blood from poisoned individuals will, if injected, produce the same symptoms in a second individual, prove the falsity of the old idea. Drugs once having been introduced into the system are more or less rapidly eliminated the same as any foreign material would be. They may or may not undergo alteration in their chemical structure before elimination.

Under the term drugs must be included not only those substances which influence the body functions through physiological action, but also any material substance used for treatment of diseased conditions. In some instances drugs affect the organism only through their obvious physical properties, or in

a mechanical way; thus, bismuth subnitrate which is non-absorbable, is extremely valuable in certain inflammatory conditions of the alimentary tract, as being a heavy insoluble powder it clings to the mucous membrane and forms a protective coating against irritating substances; again, inert oily bodies applied to abraded surfaces promote healing by protecting from irritation and presenting evaporation of fluids.

On the other hand some agents act by relatively simple chemical processes, not materially affecting the body functions but rather correcting results of disordered function; for example sodium bicarbonate is used to neutralize excessive acidity in the stomach; again, certain caustic substances have the power of dissolving animal tissue, that is, destroy undesirable growths. Another group of remedial agents which do not affect directly bodily functions are those substances used for destroying living causes of disease, i. e. disinfectants used to destroy bacteria, and anthelmintics, drugs used to eradicate intestinal parasites.

However, of all the agents used for the relief of disease, the most important and interesting are those whose value depends upon their power to produce alterations in the functions of the various organs, by a process which we know as physiological action; as opposed to chemical or mechanical effects of the type just described. The manner by which these drugs produce alterations in function has been the subject of a great deal of investigation, and while certain theories concerning the mode of action of these agents seem highly probable, we can hardly pretend to have definite knowledge on this subject at the present time. A mistake which has been made in investigating this subject is to approach it with the idea that all agents act in the same or a similar manner. The tendency of late study in this direction is to reduce the class of reactions which have hitherto been ascribed to special chemical affinity between drugs and cell protoplasm and to attribute many of the changes induced by drugs to the physical structure of the living cell, rather than to its chemical composition. At present, at least three methods are recognized in which drugs affect various functions of the body and there probably are others.

Unless a drug can penetrate into a living cell, it can only influence it by altering the rate of exchange of water and other permeating substances, between the cell and the surrounding fluid, and the degree of alteration depends upon the concentration of the drug. Certain salts when introduced into the body thereby altering the molecular concentration of the body tissues, by the laws of osmosis change either the direction or rapidity of the flow of the liquid constituents of the body and hence lead to various departures from normal function. This is generally

known as salt action. On the other hand if a drug can permeate the cell its effect is determined by the amount of the drug with which the cell comes in contact, that is, the concentration relative to the cell mass. For instance, a very dilute solution of mercury salts may destroy a few bacteria because the metal accumulates in them, while if more bacteria are present in the solution it may prove harmless to them because it is distributed through a larger amount of living matter. Different cells absorb different poisons, and this explains in part probably why certain drugs act on one organ and not on another; for example, why strychnine acts on the spinal cord and not on the heart. There are some drugs which are capable of uniting with nearly any of the body tissues. These are sometimes spoken of as protoplasmic poisons and exercise a wide range of influence, depending upon their concentration. The majority of chemical agents used in practical therapeutics show a marked preference for a certain type of protoplasm, that is, assuming that protoplasm is not a homogeneous mass as often described, but a complex emulsion containing probably several distinct chemical bodies; thus one drug affects especially nerve centers, another muscle fibre, etc. This tendency for certain drugs to influence more markedly a certain group of tissue is termed "selective action."

If the very prevalent idea is correct that many drugs produce their effects by forming a chemical union with the cellular protoplasm, one would expect to find that substances of similar chemical composition would exercise similar effects upon the body. Such indeed is the fact, and while there are apparent exceptions to this rule, which cannot be explained with our present knowledge of drug action, yet with so many known facts supporting the close relation between chemical structure and physiological action it would certainly seem that as our knowledge of physiological chemistry and pharmacological chemistry increases, so will the above mentioned exceptions disappear.

Another interesting confirmation of the theory of chemical action of drugs is the fact that the same kind of tissues in various parts of the body are usually acted upon in a similar manner. The alkaloid pilocarpine slows the pulse, increases perspiration, and contracts the pupil, actions which at first glance would in no way seem to be related; however, all these effects are brought about through the action of the drug on the endings of certain types of nerves, all these structures being supplied with this kind of nerves.

Drugs may either increase or lower functional activity. Drugs which increase the activity of any organ are said to stimulate it, while those which lessen the activity are said to depress it. The word stimulation, however, is used to convey two different concepts. Stimulation is properly used to indi-

cate an increase in the specialized function of a cell, producing as does strychnine on the spinal cord, an increase in the reflex excitability. Chemical irritation on the other hand which is wrongly used synonymously with the term stimulation, is used rather in reference to the changes in the conditions, common in all forms of living matter, that is, it indicates a change in the nutrition and growth of a cell rather than in the specialized functions. Irritation may thus be induced in all kinds of tissues and is the most common change caused by drugs in the less differentiated forms of tissue, while stimulation is met with in the more highly specialized cells, such as the heart, nervous system, or secretory glands. In many instances, the irritant action of drugs may be explained by their known reactions with the proteins of the cell; for example, substances which dissolve or precipitate proteins, or withdraw fluid from them, all tend to cause irritation when applied to living tissues. In other cases the irritation appears to be induced through a chemical action, the nature of which is not understood. When stimulation is prolonged or excessive the protoplasm generally becomes depressed and may loose its activity entirely (paralysis). In most cases an excessive dose of a stimulating poison leads to depression and paralysis. The cell becomes functionally dead, but if the failure of function does not cause the death of the organism it may recover and resume its ordinary function again. Excessive irritation on the other hand, leads to actual death and disintegration from which there is no recovery. For example, the application of an irritant to the subcutaneous tissues causes dilatation of the blood vessels, effusion of fluid and increased growth and division of cells. If only a small amount is injected this condition is recovered from with probably only a slight increase in fibrous tissue, but if the irritation be intense, the cells undergo degeneration and die, and an abscess results. Cells thus destroyed never recover as do paralyzed ones. They are either absorbed, or removed by the opening of the abscess, and their room is filled by the overgrowth of the neighboring tissues.

Stimulation and depression in the pharmacological sense are directly antagonistic effects, and drugs which are depressant tend to counteract the influence of those which are stimulant and vice versa. If the dose of a depressant be small, function may be restored to the organ by a stimulant remedy, but if the dose be too large the stimulant is not able to overcome the depression; on the other hand, no matter what the degree of stimulation, we may still lower function by the use of depressants. It is possible that the failure of stimulants to overcome the effects of large quantities of a depressant, is because in most cases those remedies which in proper dosage increase function, in

toxic doses diminish it. Drugs whose actions are in the same direction, as two stimulants or two depressants are called synergists and may often be combined to advantage; but if of opposite directions, as a stimulant and depressant, they are antagonists, and this fact may be used to advantage or disadvantage, depending upon indications.

## CIRCUMSTANCES MODIFYING THE EFFECTS OF DRUGS.

The effects of drugs on the living organism are subject to some modifications, which it is essential to recognize and thus alter the dosage accordingly. The degree of effect produced by a drug on the system will depend first upon the relative susceptibility of the organ on which it is to act, and second upon the relative quantity which comes in contact with the organ. The amount which reaches the organ depends primarily upon the amount administered, that is, the dose. It is impossible to set down an absolute dose of any drug, as the amount must vary with the patient. When administering drugs with a definite physiological action, the practitioner should be governed in the amount administered by the effects produced. As put by a recent writer, "the dose of a drug is enough." It is necessary of course, for the practitioner to know the approximate amount of each drug which should constitute a dose under ordinary conditions. Some of the most important circumstances which modify dosage are for example size and weight; if the same amount of a poison be distributed through the tissues of a large individual as of a small one, less is contained in any given organ of the former, and less effect is therefore observed. Temporary conditions such as pregnancy, lactation, etc., must be taken into consideration. Age, constitution, degree of fatness, species, and breed types in a species must be reckoned with in governing dosage. Pathological conditions modify the effects of drugs very markedly, and in a way which cannot at present be explained. Idiosyncrasy is a term used to describe an unusual reaction noted in an individual following administration of a drug. No explanation can be given for this. Abnormally rapid, or retarded absorption, or excretion may help to explain this peculiarity. One form of idiosyncrasy consists in the failure of an individual to react to an ordinary dose of a drug. This is known as tolerance, and it may or may not be acquired through continued use of the same drug. The cumulative effect of drugs is another phenomenon caused by their prolonged ingestation, and may occur along with tolerance, for instance, the tolerance of certain tissues for a particular drug may not protect others from the effects of its continuous use.

## METHOD OF ADMINISTRATION.

The effect of a drug is often determined largely by the method of administration. Other things being equal the amount of drug which is in the blood stream at a given moment, the greater will be the degree of action, but the quantity present will depend not merely on the size of the dose, but also on the ratio between the rapidity of absorption and elimination. The following outline gives the various methods of administering drugs in order of their rapidity of absorption:

1. Intravenous.
2. By inhalation.
3. Intraperitoneal.
4. Subcutaneous.
5. Intratracheal.
6. Oral.
7. Rectal.
8. Inunction.

## FATE OF DRUGS IN THE BODY.

Drugs are disposed of by the body in a number of ways. Some are oxidized by the tissues, alcohol, for example. Excretion by the kidneys, skin, lungs or by the alimentary tract is the usual fate of most drugs. The material may be excreted unchanged or it may be partially oxidized and then excreted. Most volatile drugs are rapidly eliminated through the pulmonary epithelium and carried off in expired air. The chief excretory channel for the majority of drugs is the kidney, being eliminated in solution in the urine.

## DEMONSTRATION.

Lecture was followed by a discussion and demonstration of the effects upon the heart and circulation of adrenalin and atropine. Various newer apparatus used in pharmacological experimental work was exhibited and uses demonstrated. Blood pressure tracings were made upon a kymograph by the use of a mercury manometer connected with the carotid artery of an anesthetized dog. The effects of the drugs which were injected into the femoral vein on blood pressure, etc., were plainly noted. The various means of stimulating nerve trunks by the electric current were demonstrated in working out the physiological action of atropine, etc., etc.

# Food Inspection

PROFESSOR J. W. M'FARLIN, UNIVERSITY OF KENTUCKY.

Doctor Stange, Gentlemen: I am glad to be with you people this morning to talk to you upon this subject. Of course I do not know the conditions anywhere except in Kentucky, but I do not believe there is anybody on earth that knows the conditions in the state with reference to food better than I do—that is in Kentucky. I wish I was really able this morning to state this matter to you in a way that you would really know your importance to the State in which you live as veterinary surgeons.

In Kentucky of course we have food inspection, but the provisions for food inspection, both State and Federal, are wholly inadequate. Why do I say that? You take in our state, we have four or five traveling inspectors. In the food department we have an appropriation of $30,000 a year. There are no four men in Kentucky that could inspect the meat in Louisville alone, if they were to give it their whole time. Then again, there is no man who is competent for a meat inspector except a veterinary surgeon, and when I say that I mean a graduate veterinarian.

To go back to the beginning of our work, we did not pay much attention to meat inspection. We took up milk, for the simple reason that we thought at that time that milk was the most important subject for us to look into, and I think with the work we have done that we have the milk supply of our state on the road to progress. We have in Lexington today the cleanest, best milk supply in the United States, simply because we have worked with those people until the most of them have put in up-to-date equipment. They do anything that possibly can be done to make their milk supply the very cleanest that can be had. Then we went into the bread proposition. We waked up one morning to find that every miller in Kentucky had put a bleacher into his mill. At that time it seemed to be a secret process. Without filing a single suit in Kentucky we went to our millers by correspondence and furnished with a list of questions printed on blanks. They were to answer these questions voluntarily, and seventy-five per cent of the millers answered that it was wrong to bleach flour. But yet after the reversal of the decision by the United States Circuit rendered in Kansas City, Missouri, in one case, I believe ninety per cent of our millers put their bleachers in operation. I do not know what is going to be the outcome. They are required to stamp it on the sack somewhere, but they put it in mighty small letters and you do not know whether it refers to the

sack or to the flour itself. But I believe the pure food people all over the country have gone daffy over labels. I believe if it is all right to sell bleached flour it is all right to sell it without any mark on the sack. It is either right or wrong. If it is wrong it should be cut out, and if it is right, then let them sell it. I make that same statement with reference to every other adulterated food product sold in the United States. Down there in Kentucky where men sell adulterated food products the law says it must be labeled to the consumer, not to the dealer, so that he may know what it is when he buys it. Consequently every man who operates a store that sells pickles with benzoate of soda in them must mark them to the consuming public. What good does it do for the wholesaler to sell the retail man a barrel of pickles marked on the head, when the retailer knocks the head off, and then say that is carrying out the pure food law. Carrying out the pure food law is carrying the label proposition to the consumer. It is a great big job to get every grocer in the country to label these adulterated products, but when you permit the selling of adulterated food products you put a premium on them to the detriment of the pure stuff. Consequently—and I may state that I am responsible for what I do and say absolutely to nobody else—every time I have an opportunity, either in the home office or out in the state, I am going to oppose the sale of any adulterated food products, whether it be meats or groceries or whatever it may be. I think it is wrong and I expect to oppose it in every way I possibly can.

Now then, after we had a round with the milk and bread, next thing, naturally, was the meat. Well, I had been going around the country a good deal, but I had not been in a slaughter house. I had seen meat markets through the front windows, but I had never investigated. So along about 1908 Mr. Ellis and I were talking one day, sitting in the office smoking, and we were discussing the necessity of inspecting meats, and finally we decided to make a thorough investigation of slaughter house conditions in Kentucky. Now of course none of you people can take exception to what I have to say about my own state. I am not going to say anything about Iowa, or Missouri, or any other state, because you know whenever you get away from home and go to talking too much, like I frequently do, you are liable to go up against some fellow who is going to differ with you in what you have to say. Consequently, this morning I am going to give you some of the butcher business conditions straight from the shoulder—as they have been in the State of Kentucky. Do not apply what I have to say to any other fellow, if you please.

We started with the slaughter houses. We have a score card, and on that score card there is a blank line upon which you can write anything you might see about slaughter houses. It takes a pretty good-sized card when you find them in the condition that we found them down there. I never dreamed that any man, any place on the face of the earth, after all of the publications and all of the letters and things that had been written to try to clean up and make sanitary the places where food products were manufactured—I never dreamed any man would try the production of food under conditions that existed in those slaughter houses. You know what they did? You would see the slaughter house, but it would be built up from the ground like it was a place where the water might rise. Let me tell you why that was done. They would have a fairly good floor with a gutter in it. This gutter would just be built long enough to go through the wall. They would kill stock there and shove the offal through that hole out onto the ground until it would get so high they could not shove it out any more, and it would be nothing but a mass of rotten flesh and green flies. We went through the entire state and we found just such conditions as that to exist. And usually they would have a bunch of hogs running around this pile of refuse and eating it, and they would kill the hogs right out of that lot and sell them to the consuming public to eat. It does not look like anybody would do a thing of that kind. But I want to say this, that possibly every man who operated one of these places was apparently, and I believe at heart he was, a good citizen as you will strike anywhere, but it was that old fashioned custom that they had been used to for years. It was just like the dairymen. You take a German dairyman who has been in the business for forty years, and you cannot make him believe any way is better than his. You have to teach his boy and let the old man die and then you can build up the business the way it ought to be. So it is in the slaughter house business. These people many of them have been in the business for forty years; they have a good deal of money invested, and that is one of the great drawbacks we have had in promoting the only remedy that you or I or anybody else can figure out for this condition, and that is the central slaughter house or municipal abattoir. That is the only way it can be done, no matter what I think or what you think.

We then went into the cities, and in our largest cities we found conditions just as bad as we found them out in the country. With all of the health officers and all of the policemen and sanitary offices and everybody else, we found condition in the cities just as bad as in the country in some places. What did we do there? We just simply made up our minds

that we were going to have those places sanitary, and if there was any way on earth we would have local investigation. The pure food department of the state cannot inspect a lot of this meat, and so we got together with the State Board of Health and the butchers, and I want to say that when you go to make any improvement any place the best kind of people to get hold of to make any progress are the good butchers, and the good dairymen and the good grocers, as the case may be. You cannot fight them; no man on earth can get away with the butchers; the only way you can get through is to have them take the matter up and carry you through. I have been there and know what I am talking about.

We went down to Louisville and inspected slaughter houses. And you know when a fellow first starts out he thinks he knows more than any other fellow on earth. I thought I knew all about this business, knew just how to run things, and I inspected those slaughter houses, wrote the score card and then walked down and had 143 of those fellows summoned to appear in City Hall. And the war was on from that time. They came, and they had money enough to employ the best legal firm in town, and they did it. They organized themselves into a protective association, and there was what I was up against. I thought I had made a little mistake, but if a man is honest and sincere in his work there is always a way to get by.

The next dream I had was to get these people to agree upon a set of regulations—have all the butchers over the entire state agree to it as far as possible. And no butcher but would admit that he ought to run a clean place. There are butchers who do not believe in inspection, but they all admit that they ought to run a clean place, and you go into any slaughter house in this country and if it is dirty the man will tell you so. He will say, "Yes, I will admit it is not what it ought to be," but the thing is to get him to make it better.

We submitted regulations to the butchers and they accepted, and the better class agreed to comply with these regulations, and they said, "We will help you put any butcher in Louisville out of business that does not comply." They knew it was up to them. But they did not want to establish a municipal abattoir. Why? This for these reasons. They had their own plants and they had been operating for years, many of them had quite a good deal of money invested, and they all seemed to think if they went into a municipal abattoir it was a confiscation of all that property, which is a mistake. But they regarded it that way. Another thing, a good many butchers in Louisville have always tried to be first-class, honorable, upright butchers. They have tried to kill good stuff, they have

built up a reputation of their own that they did not want to give up. They had a right to object, and for that reason they were opposed to this plan. Then again there was another bunch of butchers down there that I know never would kill an animal that they thought was all right; they would not buy it if it was all right under any circumstances if they knew it. You know what a hard time a man like that would have in a municipal abattoir. So he fought as hard as anybody. That is a fact, and if you don't believe it I can furnish proof—all the proof you want. They went out and bought any kind of stuff; they did not have meat inspection and they could get just as much for that meat down town. You cannot tell what kind of beef it is after it is ground up into Hamburger; you cannot tell whether it is horse meat or beef, I want to tell you. I am not a veterinary surgeon and I never expect to be, but whenever you go out in the world and somebody asks you the difference between horse meat and beef, you be very careful how you answer the question. If not, you will get into trouble.

Now we went ahead to fight for a municipal abattoir—six long years in the city of Louisville—seven years now. I got on the good side of all the better butchers in towns, and maybe they were afraid of the pure food department, but they fixed up their places and put in concrete floors and concrete walls, sanitary connections, hot and cold water, everything up to the regulations. But somehow they did not want that meat inspection. There were reasons for that. When the inspector condemned an animal he could see himself losing that animal. But to make a long story short, we got the thing going along all right and got the slaughter houses in pretty good shape, and then they had a meeting one night and Dr. Grant, the city health officer in Louisville, one of the best health officers in the country, stood up and said, "Gentlemen, it is utterly impossible to have meat inspection without a municipal abattoir. He was sincere and he believed he knew what he was talking about. But there were three other men in town—Al Cook, John O— and Joe H—. What had they been doing? They had been buying horses at from fifty cents to two dollars a head and killing them and making Hamburger out of them. I had visited this slaughter house for seven years. Of course you are not supposed to go into everybody's horse barn when you inspect a slaughter house. But I started out again. I went to a place called a gelatine works. It is a glue works, but they call it a gelatine works in order to locate it inside the city limits, so it is a gelatine works that makes glue. I went out to this glue—gelatine—works one day. They had had trouble out there, and a man by the name of Conrad asked us to come out and we went, and right across the alley from his place of business this man Al Cook—who used to be a

butcher but he operated such a bad place they made him quit—lived. He did go down and went to killing for Armour, but he quit and went back home and went to trading in horses. Right along the alley there was a double gate that opened into his lot, that had a board fence around it. The gate stood open most of the time. The full length of that lot he had a wire stretched, and he had two bull dogs, a collar on each one and a chain from the collar up to this wire, and they just swept from one end of that yard to the other, and you know how a bull dog will pull against a chain. And when the gate was open, every man that came along, they would just come tearing down that yard. A man would no more walk into that lot than into the mouth of a cannon that he knew was loaded.

But I noticed he had a good many horses, and another bull dog back there. I never saw so many bull dogs. I just thought there was something wrong, and that was a fact. I decided to go in if there was any way of getting in. Now Al Cook run one of the old kind of slaughter houses. I went around to the front to get in. The door was shut, but right between his house and his neighbor was a little pavement, and I went down there to see the chance of getting in, but he had another bull dog down there; he had a little house built there. Then I went to the front door and rang the bell and by-and-by a little boy came, and I said, "Is your dad at home?" "Yes, do you want to see him?" "Where is he?" "He is out at the barn." He let us through, and Al Cook had four horses killed in that barn and had the meat piled up, a pile on some hides on this side, and another pile on some hides on that side. P—— asked Al, "What are you going to do with that meat?" "A fellow out here raises fox hounds and I'm going to sell it to him." "How many hounds has he?" "Four." (Laughter). He realized immediately that this horse meat was a good deal for four hounds—four large horses for four fox hounds, but he did not say anything more about it. We came out and down town and we discussed the matter, and I said, "P——, he is selling that meat, selling it to people to eat." I knew Al Cook and had known him for years. We had to get busy and find out somebody that had bought that horse meat from Al Cook for beef before we could touch him. We went back over to the gelatine works. Conrad bought a good deal of meat that was too bad to use as horse meat even, and we made him show his books, about what he had purchased in the last thirty days from Al Cook. The first four days he bought about 1,800 to 2,000 pounds—about two horses. He sold the hides to the tannery. Then for the next twenty-six days after that he sold him 200, 180 and 400, that is, he sold him two frames, without the meat or the hides—that is about what the green frames will weigh. That is as far back

in the record as we went. Then we asked Conrad if he had bought any tainted meat lately, and he looked at his books and said yes, within two days he had bought 900 pounds of tainted meat from a man named Gregory who lived out on Shelby street. So we got on the car and went to the number and went in. The man was at home, and another man lived in the house with him by the name of Robinson, and there we found Al Cook had sold these people that 900 pounds of horse meat for beef. One paid him for his beef in money and the other by check. He furnished the check stub and then the three of us got on the car and went down to the health office and made affidavit to this transaction. Then we had Al Cook arrested and got the ball rolling. Got three of them convicted and put in jail.

All of this is to show that in the matter of meat inspection you must have public sentiment with you first. You might go up against a city council, and they are the best fellows in the world, but when you go before them to get a milk inspection ordinance or a meat inspection ordinance or any other kind, it is the hardest job you ever went up against unless you have public opinion behind you and pushing you. After that horse meat episode in Louisville, what happened? Public opinion went just as high as it could go in opposition to the way the meat business was done in that city. It was not long until council met and passed an ordinance providing for a municipal abattoir; introduced an ordinance providing that the city health officer had a right to specify the kind of a slaughter house in which meat should be slaughtered for food, and he had the power to eliminate all slaughter houses operating in the city of Louisville that were not up to his specifications; consequently the number was cut down from sixty to something like twenty-five. Today every time an animal is killed in the city of Louisville a veterinary surgeon, a graduate in most instances (there are two or three fellows put on that meat inspection that I do not know how they got in, but the boards always leave places to stick somebody in some time for some purpose,) but outside of these three or four they are graduate veterinary surgeons, and they inspect the meat. But if we had not had that horse meat episode we never would have had meat inspection in Louisville.

We have in Hopkinsville a municipal abattoir with meat inspection—a town of 8,000 people. In Russellville there is just one slaughter house, same in Winchester and in Henderson, and in quite a number of our towns, and we are fighting all the time to get a veterinary surgeon in every county seat town to be the inspector. The veterinary surgeon can not only treat horses and cattle, but he can act as meat inspector. That is

the only way we will ever be able to do it. I have had as much experience as anybody of my age in the meat business, but I would not qualify for a meat inspector because I know nobody can do that but a veterinary surgeon, and for that reason I wish I could make it known to you gentlemen how much you are needed in this country and how important you are to the consuming public, if your qualifications are what they ought to be.

Why did we recommend a municipal abattoir? I will tell you why. We went all over this country to see what they were doing. We saw it, and I will make reference here to one. I hold in my hand the original paper of facts that I got at a municipal plant inspected by a graduate veterinary surgeon, Dr. Roberts, in Nashville, Tennessee. He is paid by the state. What did I find there? About fifteen years ago these people started a municipal slaughter house at an expense of about $10,000. From its very beginning it has been a money-making proposition. It belongs to the butchers in the city of Nashville. There may be a few outside parties that hold stock in the concern, but it was originally to belong to and be controlled by the local butchers. The butchers themselves told me they opposed it at first. "We did not like the plan; we did not like to give up our old places; we had money invested." But they said. "If I had a slaughter house that cost me $5,000 and it costs me a dollar to kill a beef in it, it certainly is better for me to come down here and kill it for 75 cents." That is what they did. They sold stock in blocks of $500 so everybody could get in, and they all got in. The fee is fixed the same for everybody. You get your cold storage for nothing as long as you want it, and they kill cattle for 75 cents a head; they will kill 100 hogs for $15 and refrigerate them; they kill sheep at 15 cents, and calves 25 cents a head. That is the fixed price and has been the price all the time. What other advantages do they get? They have an ice-making plant, and that plant makes 4,000 tons of ice a year. When the butcher comes down to get his beef he gets his ice and takes it with the meat and hauls it to market. He has his meat drained off before he leaves the plant and when he puts it in the meat box it does not drip, therefore his box is clean and nice, his meat is cold and it does not take half the ice it would otherwise. There is no comparison, there is no other way to do it right than by a municipal abattoir.

And then the matter of meat inspection. I have visited a good many slaughter houses, and I never saw a butcher condemn a piece of meat. They always buy the right kind, and they "would not sell anything that they would not eat themselves." That is what they tell you. I know a good many that say that, and they believe they do—but they don't. I went

down there one day and sat there thirty minutes and they condemned ten hogs—some had cholera and other things. We went down there and had the best photographer we could find take some pictures for our Bulletin 173, and if you want it we will send it to you. We hope it will do some good somewhere.

Now these people were kind enough to let me into their books to get my facts concerning that slaughter house. Here is what happened:

In January, 1912, they condemned four head of cattle, twelve hogs, and three sheep and eight calves. I do not know how much stock they killed in January, 1912, but is it not fair, is it not reasonable I ask you gentlemen, is it not reasonable to suppose that out of the same number of animals killed anywhere else than in Louisville, in uninspected slaughter houses, is it not reasonable to suppose the same number of animals would contain just as many diseased animals as were condemned in that lot?

In February—2 cattle; 1 hog; 1 sheep.
March—8 cattle; 3 hogs; 12 sheep; 3 calves.
April—5 cattle; 11 hogs; 21 sheep; 5 calves.
May—1 cow; 6 hogs; 4 sheep.
June—1 cow; 8 hogs; 14 sheep.
July—4 cows; 2 hogs; 4 sheep.
August—2 cattle; 32 hogs (cholera must have broken out about that time); 3 sheep; 1 calf.
September—9 cattle; 1 hog; 1 calf.
October—5 cattle; 16 hogs; 3 sheep; 8 calves.
November—8 cattle; 5 hogs; 7 sheep; 3 calves.
December—11 cattle; 11 hogs; 2 sheep; 14 calves.
Making a total of:

| | |
|---|---|
| Cattle | 60 |
| Hogs | 101 |
| Sheep | 79 |
| Calves | 42 |

And in addition there are 15,000 pounds of parts condemned each year.

Now as to the cause of condemnation—cholera, excessive bruises, decomposition, tuberculosis, certain parasites, advanced pregnancy, tumors, lung choke—and a number of other causes.

Now what other advantages did they have. The workmen were all skilled men, men who knew how to skin cattle without injurying the hide, consequently they got more money for their hides. That abattoir will pay the small dealer in town three-fourths of one per cent more per pound than any small dealer can pay. Why? They collect them in carloads and ship them to the tannery and save freight, something like $23 per car, and then they get more for the hides because they have been taken off by skilled butchers. And they carry that

out all through. The lowest price they got for any by-product at any time was $26.50 a ton. They save the bone and hair and almost every drop of grease. They say they save the bladders and get ten cents apiece for them. There is where the money is in slaughtering. For instance, a butcher has his own cattle killed, they buy the hides and give him three-fourths of one per cent more than anybody else, they pay him ten cents for the bones of the head and feet, and the balance of the offal the association gets. Then they run his beef in the refrigerator. It is the nicest thing you ever saw, and I can tell you the only way is a municipal slaughter house where it is possible. Nashville is a city of 150,000 people, and every butcher is in that one slaughter house. Then they have the Tennessee Packing Company and the Federal plant.

As to Federal inspection, you know as well as I do that while it is a good thing as far as it goes, yet it does not always go far enough. Why? You take for instance part of my state, the meat is shipped in from East St. Louis. The meat is killed in the Federal plant and is inspected, stamped by the Federal inspector and passed. But that is a good piece from my city. It is shipped to Kentucky in a car, the car runs local like a carload of barbed wire fence, and when they get to the station they open the door and throw it out—and on they go. In every city like Owensboro or Henderson the meat is liable to go wrong, that is, the car is sometimes shipped wrong, the ice melts in the car, and there is a whole car of meat to be condemned—that is, it should be. I am not going to say whether it would be out here in Iowa, but it might be. I do not know about the slaughter houses out here; they may be dirty; I am not going to say; but I do say that when the time comes that you make a thorough investigation I am satisfied you will find some of them dirty. The Federal inspection is all right, but they cannot have Federal inspectors everywhere. Here not long ago a carload of meat came in, and we were going through the cold storage plant and found fifty-nine barrels of pork loins, and we called them spoiled and turned them over to the fertilizing plant. They said they were not spoiled, but they were fixing to spoil. (Laughter.) So in going these rounds if you look into a lot of meat boxes in butcher shops it would surprise you how often you find meat that is "fixing to spoil." I have thrown out as much as 850 pounds out of one meat box that was "fixing to spoil," and 350 pounds out of the meat box of a restaurant where they were cooking for the consuming public, that was "fixing to spoil." It would surprise anybody to go through the meat boxes in their own town and see the conditions that exist. There are a lot of them that keep the meat

hanging up in the box and they do not dream that the floor of the meat box ever needs to be cleaned.

There certainly is a revolution down there in this meat proposition, and we are going to keep at it, and as sure as the Lord makes little apples we are going to have some more veterinarians down there, from somewhere, I don't know whether from Ames or not. There are State Food Commissioners, but I say to you right now that every food commissioner that does not take up this meat proposition and see that there is meat inspection is utterly unfit to hold the position he does hold in this commonwealth. I know what I am talking about. I know Kentucky is one of the best states in the Union, that we have just as good conditions there as in any other state, just as good slaughter houses, just as good cold storage. I do not know about the whiskey, horses and women, I am talking about meat. We have these things just as good as any place on earth, and Louisville is a good city, a clean city, lots of money, good health officers—but yet they killed these horses and sold them to the consuming public to eat, and they might do it in any other big city. I know the meat inspectors in Chicago do not go into every horse barn to see what they are doing. It was chance that got us in there.

Another thing, the local meat man is losing his business just because of these conditions, because of not having good inspection. You take Lexington—Dr. Roberts worked there—and in Lexington 85 per cent of the meat is sold by packers. Why? On account of local conditions of slaughter houses and not having meat inspection. These packers put their signs up saying their meat is inspected and passed by U. S. inspectors, all of which is effective, and they have the best meat in the country.

Then again, the local butcher always gets what the packer don't want when he goes to buy. He will go out in the country, and lots of places they do not feed cattle for beef—he will buy anything running up and down the highway, anything he can get he has to buy, and it is impossible for him to have meat like he ought to have it.

As I say, we want to establish a clean, wholesome meat market; we want to hold up this matter of meat inspection to as high a standard as anything else. Butcher products should be required to be inspected just the same as anything else, but while we are absolutely successful in the inspection of groceries and restaurants and all those things, the meat market is the only thing in our state that we have to hold up our hands and say it is utterly impossible for the department or anybody else excepting the local people to do it. There must be a local man in order to have meat inspection what it should be. We never can have in any locality, I do not care whether it is Kentucky

or Iowa or anywhere else, we never will have clean meat, free from disease, for the consuming public to eat until they have established local meat inspection with a competent veterinary surgeon. (Applause.)

Dr. C. H. Stange: If there are any questions you would like to ask, I think Professor McFarlin will be glad to answer them.

Prof. McFarlin: I was at a place the other day where they made kind of hot with their questions, so I have established a rule, and when a man asks me a question I say, "My name is J. W. McFarlin; I live four miles from Louisville; I am a meat inspector. Will you please tell me your name and address and business so I may know who I am talking to." I will be glad to answer any questions if I can, and if not I will tell you so. But before you begin with the questions let me say this, that if any of you gentlemen should come to Kentucky, come up to our place, come out to the Experiment Station to see us. We will give you a royal reception. We are always glad to have people come from any place in the country, and if we can give you any help we will be glad to do it, and we ask the same thing of you.

Another thing, I believe every veterinary surgeon ought to keep in his mind the plan of a good, economical slaughter house with the proper equipment, and when you go out in your localities then you are able to talk intelligently to anyone who wants this information. I know there is no better thing a veterinarian can do than to help in the establishment of this local meat inspection all over this country, and nothing is more needed.

Question: Do you consider horse meat absolutely unfit for human food?

Prof. McFarlin: Not at all. But if it costs fifty cents for a whole horse, I do—or even $2.50. I would rather eat a piece of fifty-cent horse than fifty-cent cow; but I would rather eat a piece of good beef than fifty-cent horse. There would not have been any objection to horse meat if it had not been misrepresented and sold for beef. They have horse meat markets in France where they sell nothing but horse meat.

D. H. Udall: I am D. H. Udall, of Ithaca, New York. Recently the municipal inspection of meat markets has become quite a problem. A city inspector has been appointed, and he happens to be a man in the department of medicine in the veterinary college, and that gives our department of medicine some little responsibility for the work, though it is done really through the university. A lot of the meat is brought in in carloads, but we have about one dozen butcher shops in the town and three or four private slaughter houses around town, and a good many farmers raise their own meat. These farmers kill

for themselves, but we are supposed to inspect all of the meat killed in that way and all the meat killed locally, and while this man is away I have to inspect the meat for a month or so. It is often necessary for them to bring in the carcass, with the head and feet. I would like to know something about proper meat inspection.

Prof. McFarlin: At Nashville anybody can bring stock to that abattoir and they will kill it at the same price. Anybody who kills in the county, under the ordinance, must bring that carcass to that slaughter house. They have a long porch on the side with hooks against the wall, and a man brings in a carcass and hangs it up on one of these hooks and then asks the veterinary surgeon to come down and inspect it, and he inspects the meat and puts his stamp on it. You cannot sell a piece of meat in Nashville or Louisville that does not have that inspection, and everybody who kills outside, they have to bring the meat to this slaughter house and they have to bring it at the time when inspection is going on, and the inspector inspects it, puts his stamp on it, and the man can go on to market. That is the only way to do it properly. It is the same for everybody. It is not right to inspect one man's meat and not another, so they make them bring it to that point. When I was in Louisville last year I saw five wagons come in, and they hung up their meat and then notified Dr. Reed and he came down and inspected the meat, stamped it, and the men threw it in their wagons and went on.

If the people ever could see—I was in Chicago once and went down to that place where they kill all the condemned beef, and I never saw such a sight in all the days of my life. I reckon they kill all night. I went at five in the morning and had some trouble getting in, and I saw—well if people could only see these things there would be no trouble in the world in having local meat inspection in every place of at least 1,500 people. But the people do not know. There is not one person out of ten thousand that ever goes to a slaughter house, and out in the country they always put them away back in a field or up some hollow where nobody ever goes. Right in my own town I went before the city council and had some of the butchers go, and they wanted to build a good, clean, concrete slaughter house down at the stockyards, but that council would not let them do it. They have not been educated up to that point yet; they know the slaughter house as it exists in the country now. If we had had a council like they have in Ashland there would not have been any trouble. There they have a slaughter house right in town, but when the stock comes in it is killed and hauled right away, and then the hose is turned on and you would not know there was a slaughter house there. Same way in Newport. And

when I see anything in my rounds that that man would like I tell him about it, because he wants to keep up to date.

The slaughter house is like the kitchen. You take a piece of rotten meat in the kitchen and it will smell bad, but fresh meat is all right. Same way with offal; you get rid of that offal while it is fresh and it will do no harm. It is a matter of doing things at the right time and in the right way. They never have had any trouble in these places and never will. The only thing is they do not have a veterinarian always for inspector.

Dr. C. H. Stange: How would you suggest that a man should broach the subject, and who would be the best person to stimulate interest in an abattoir?

Prof. McFarlin: I believe the best fellow in any town is the veterinarian, and if there is any way on earth that he could go to every home in town, I would do it. You have to get to the people. When you talk to the people the most of them are broad-minded enough to listen, and whenever they know a thing is right they do not care for you or anybody. But you have to get them in the right mind. If you go right out in the open and do it you will not make a mistake. You must get that element behind you that will carry public sentiment with them and consequently with you. In all these instances council has to act. I have told you what you have to do to get council to act. That is what caused my hair to leave, trying to get council to pass ordinances.

Dr. C. H. Stange: It would seem to me the question of municipal meat inspection is going to be one of such importance that the veterinarians should get as much information as possible on this subject. It is a question that is debated more or less at all times and the women are very much interested. I would like to have you ask Prof. McFarlin any question you might think of at this time in regard to how we can get the work started.

Prof. McFarlin: I do not know what the food law is in Iowa, but down in our country we would not have any execution of our food laws if we did not keep after these things. That is the reason I took the matter up, and after I got into it I would rather work at it than anything. It is the greatest thing you ever saw. You are liable to get bawled out and cussed out, but you know the people in our state like excitement, no matter whether it is in the butcher shop or on the race track, the thing is excitement. This meat business is the greatest thing you ever saw.

Question: Do you have a constructive plan whereby this matter of municipal abattoir and inspection can be offered as a resolution or something of that kind?

Prof. McFarlin: We have our Bulletin 173, I think that covers the matter. Of course when you know the conditions you can get something better, more specific, but in a general way I think Bulletin 173 covers the ground pretty well. But of course it is three years since it was issued.

Question: Do you find that it works out in small towns? Are you able to accomplish anything in small towns?

Prof. McFarlin: It is bound to work out for this reason. If you go to any place—even one thousand people—everybody will agree with you that they do not want a slaughter house. That is enough. But they will not object to a clean, concrete slaughter house, screened. Then the thing is to talk one slaughter house. You take Louisville, when we commenced there were sixty slaughter houses, and it would take sixty men doing nothing else, because they killed every day. That pork loin case is the one instance I have ever known that passed the Federal inspector. I do not believe the inspector ever saw that meat. They took it for granted it was inspected. But it was bought so much cheaper than the market, so you know there was something wrong—it was "fixing to spoil."

You cannot get local inspection by talking Federal, because the local inspection is far better. If a carload of meat is shipped down to Ames would it not be better to have local inspection? This livestock inspection is not worth anything for meat that is to be slaughtered. At the municipal abattoir they inspect after they kill, and that is the time to inspect. The inspection is all right, but the inspector is in the yards and he is supposed to examine after they slaughter, but they cannot do it. And then in this matter of inspection I believe if a part of a carcass is saved from an animal that had any disease, I think it ought to be labeled. I think the man that buys ought to know what he is getting.

Dr. Wood Hampton: How about a small town, say a town of 800 people, with one butcher. Would that be a municipal plant for that one man?

Prof. McFarlin: It is hard to draw the line in those between the actual user and the butcher. You see a man that kills one or two or three animals a week is almost like a farmer. Where these little towns are scattered far and wide I do not see how they would ever carry it out unless some veterinarian would voluntarily go and inspect. But we are driving at places that have enough people to justify inspection, where the veterinarian can get something out of it—where it will be something worth his while to do. The standard of your profession must be upheld, and I believe in holding it high. In my state the veterinarian is not what he should be. I do not know whether half

of our men are graduates. But there is no way to change it until we get better men in there. We try to establish meat inspection where it is really needed. Now Ames ought to have meat inspection. Don't you know that sometimes meat is sold here that is diseased, not fit to eat? But it does not lose anybody anything. At Nashville if a butcher goes out to buy hogs he says, "I will give you so much, just as they are." Or "I will give you so much and you stand the inspection." Then the man necessarily is the loser. It is really better for the butcher to be the loser. Why? Because they can sell it for fertilizer. Take an old, poor cow that sells for a cent and a half or two cents, and she will sell for that much to the fertilizer plant and nobody is the loser. And if the butcher belongs to the association he gets his part of it. They are pretty well divided in the matter of stock. A man told me he had put about $2,000 in it. This was about three years ago, and now he says that stock has never paid him less than six per cent and he can sell it for $10,000 today.

So you see what an investment it is. They sell all the offal and make something out of that; all the tankage brings a good price. One man sends his tankage wagons around to these little slaughter houses and gets the offal. He will pay them a little something for the shanks of a big beef, but he takes what they give him to get rid of it, and he has made more money than all the butchers in Louisville put together. I am satisfied he is a millionaire. He was shrewd enough to see where the money is in the meat business. Very few butchers make a fortune, but the man that handles the offal does.

Dr. Wood Hampton: Has there been an instance where there was a municipal plant installed and the towns adjoining, say for eight miles, would go in on this plant?

Prof. McFarlin: I do not know of any, but I do not see why it would not be easily done. Most men go six or eight miles, and if they had an established plant they could just as well kill there. They could have a dripping room there and run the meat in there and let it hang all night where the blood would drop on a concrete floor and save it. Then they could have cold storage there and the next morning it would be cold and that would save on the ice.

I am satisfied you gentlemen have the idea, and I hope you will be successful. I know there is nothing on earth that can do more good in the food line than to have meat inspected.

# Breeding Problems

H. D. BERGMAN, AMES, IOWA.

Gentlemen: I believe you will all agree that the subject as assigned for this period, "Breeding Problems," is broad enough and important enough to take up the full two hours assigned and a good many more. You saw this morning, an excellent demonstration of the anatomy of the reproductive organs, and it would seem proper now to take up a short consideration of the physiology of the reproductive organs.

As a number of our breeding problems are the result of interference with, or failure of, normal physiological functions. it is essential that a general knowledge of the physiology of reproduction be attained before undertaking a study of a subject such as "Sterility" which is indeed the vital problem in breeding, and which will be considered this afternoon. I have taken as a sort of sub-subject under the general subject, "Some Physiological Phenomena Relative to Reproduction," upon which I should like to talk for a while, after which take up a problem of breeding which has been talked, practised, and abused a great deal in the last few years, and of which I believe the average veterinarian knows too little, i. e., that of artificial insemination and its practicability and significance in overcoming certain causes of sterility.

## SOME PHYSIOLOGICAL PHENOMENA RELATIVE TO REPRODUCTION.

Probably with the exception of the phenomenon of consciousness, there is no fact of life that is more interesting, or offers more difficulties to a satisfactory explanation, than the physiological function of reproduction. Two cells, the spermatozoon and the ovum, unite to form a new cell which at once begins to grow rapidly, and produces an organism that in all its peculiarities of structure and function is essentially a replica of its parents. The obvious fact that the fertilized ovum of each species develops into a structure like that of its parents brings forth a fundamental problem essentially of a physiological character, i. e., that of heredity, and which must ever bear a close relation to the study of animal breeding. The phenomenon of fertilization itself, is a problem upon which although much progress has

been effected, and many new facts discovered, yet the actual nature of the process whereby the ovum after being discharged from the ovary is endowed with a new vitality through union with a spermatazoon, or why union with a second cell is at all necessary is a question the solution of which is far from complete.

That portion of the physiology of reproduction that can be studied with most success is the structural changes that are associated with fertilization and reproduction, together with the various accessory functions connected with the genital organs, which functions are necessary to the final union of the reproductive cells, and which are, in a measure of more immediate practical interest. These accessory phenomena of reproduction form a part of the reproductive life which comes more immediately under our control, and which is moreover, more accessible to investigation and are the ones which have at present the greatest practical interest. The physiology of reproduction in general covers so wide a field and is related to so many branches of biology, that even a superficial presentation of its most salient features would require more time than is allotted, hence we shall limit the discussion to certain factors associated with the phenomena of reproduction, the significance of which should be thoroughly understood by the veterinarian in order that he may be able to intelligently assist his clients in solving various breeding problems.

The physiological importance of the sexual or reproductive organs lies not particularly in their co-operation in the communal life of the various parts of the body, but in their adaptation to produce another similar being. In fact, except so far as the supposed internal secretions of certain of these organs effect general or specific metabolism, they might be eliminated entirely and the power of the body as an organism to maintain its individual existence not be seriously interfered with. The sexual organs are essentially concerned in the propagation of the species. In the higher animals in which the sexes are separate, in order that generation may take place it is necessary that the two sexes be placed in favorable relations with each other. Nature has ordained that the creative act should be accomplished by engendering in the individuals concerned, an in-

stinctive and irresistible desire for copulation at certain stages, which desire continuing only for a brief period, is renewed at regular intervals until the faculty of reproduction ceases.

## THE BREEDING SEASON.

The approach of the breeding season in the majority of animals is marked by a display of greater vitality, as manifested by an increased activity, which relates not merely to the sexual organs but to the whole metabolism of the body. This enhanced vitality as a rule is maintained throughout the breeding season. The periodicity, or the regular revolution of the breeding season, which is such a well marked feature of animal life, particularly in temperate climates, seems to be a phenomenon governed largely by the extremes of summer and winter temperatures to which the animals are exposed. Every individual requires a certain duration of life to achieve its individual development from the egg to sexual maturity and full growth; the length of time required for this varies and bears no proportion to the size attained. If, for example, from any cause the period of individual growth in certain of our domesticated animals became changed in consequence of a marked earlier, or slower development of the embryo, a large number of the offspring would certainly die either from the severe heat or cold. It would seem then that the periodicity of the breeding season may be governed to a certain extent by the necessities of the young, in other words, the restriction of the breeding habit to certain seasons may have been brought about under the influence of natural selection in order to meet the necessities of the offspring.

The origin of the breeding season is a broader question. That it may be influenced through the alimentary canal is demonstrated by the stimulating effect upon ewes of certain feeding commonly known as "flushing." The exceptional vigor and bodily "condition" demonstrated by the restless activity of both males and females of all species might point to a nutritional basis. The fact that it is frequently associated with nutrition, and that it is a stimulus gradually collected, is indicated by the increased frequency of the breeding season among domesticated animals as compared with allied species in the wild state. These and similar well known facts, however, do not entirely explain the origin of the function. They only show that sexual instinct is seasonal, and that nutrition, whether affected by external or internal factors plays an important part in its manifestation.

## THE PHENOMENON OF HEAT (OESTRUM) IN LOWER MAMMALS.

The term sexual season designates the particular time or times of the year at which the sexual organs exhibit a special

activity. It is the season during which copulation takes place, however, copulation only occurs at certain more restricted times; the periods of oestrous or oestrum. The male sexual season when there is one is called the "rutting" season, but in many species the males are capable of copulating at any time, whereas in the females this function is restricted to definite periods.

The phenomenon known as heat in lower mammals, resembles in many respects menstruation in the human family, and they may be regarded as homologous functions. It constitutes a period of sexual excitement occurring one or more times a year and during which the female will take the male. The condition lasts as a rule for several days, and in the female is accompanied by changes which resemble those of menstruation. The external genitals may become swollen and in many animals there is a discharge of mucous, or mucous and blood from the uterus. Histologically, the mucous membrane of the uterus undergoes changes similar to those of menstruation, i. e., the membrane becomes congested and exhibits a phase of degeneration during which some of the epithelium may be cast off.

## THE OESTROUS CYCLE.

The non-breeding season or period of rest in a female mammal, when the generative organs are relatively quiescent, the animal showing no disposition to seek out a mate, is called usually the anoestrous period or anoestrum. This period is usually prolonged in most animals and its close marks the beginning of the sexual season. The first part of the sexual season is occupied by the proestrum and is characterized by marked changes in the generative organs. It is the period referred to by breeders as the time when the animal is just "coming in season."

The next period oestrus or oestrum marks the climax of the process and is the special period of desire in the female; it is during oestrum and only then in most mammals that the female will receive the male and fruitful coition be rendered possible. The period of proestrum and oestrum are commonly referred to together as the "heat" or "brunst" period and no attempt is then made to distinguish the time occupied by "coming in season" and the time at which the female will receive the male. If conception takes place as a result of coition during oestrum, this period is followed by gestation, parturition, lactation, etc. If, however, conception does not occur during oestrum the latter is succeeded by a short metoestrum during which the activity of the generative system subsides and the organs gradually resume the normal condition. In certain ani-

mals, for instance the dog, the metoestrous period is followed by a prolonged rest or anoestrum. In other domesticated animals such as the horse or cow the metoestrum may be succeeded by only a short interval of quiescence. This short interval which may last only a few days is called dioestrum. This is followed by another proestrous period and so the cycle is repeated until the sexual season is over. Such a cycle consisting of four periods proestrum, oestrum, metoestrum, and dioestrum is known as a dioestrous cycle. The number of dioestrous cycles in one sexual season depends upon a successful coition taking place during oestrum. If conception takes place during the first oestrous period of the sexual season, there can be no repetition of the cycle until after parturition. If conception does not occur at any oestrum during the sexual season, the final metoestrum is succeeded by a prolonged anoestrum or non-breeding period. This is eventually followed by another proestrum marking the commencement of a new sexual season. The complete cycle of events is called the oestrous cycle.

The sexual seasons in animals vary a great deal. Probably in wild animals oestrum appears only once a year. Domestication, in assuring food and shelter and removing the animals from the alternations of an erratic life, as well as the judicious bringing together of male and female, has multiplied the periodical returns of this condition and also changed the time of the periods. The mare is usually in heat from March to September; the bitch comes into oestrum usually in the autumn and springtime, although the smaller breeds may show the condition three or four times a year. Oestrum appears in the cow at any time of year, midsummer being the common sexual season. Care of course is taken to induce conception in the cow as soon as will insure best results as regards the lacteal secretion. In sheep, heat is naturally present in September, but may be induced at an earlier period so as to obtain two lambings a year. The cat shows oestrum in January and February and in the spring and autumn and may produce young three or four times per year. The pig manifests oestrum in October and November, at least these are the usual breeding months, although breeding may be induced toward the end of spring in order to have two litters in a year. The duration of the period of oestrum varies in the different animals from one to fifteen days, the shortest period being seen in the cow and sheep and the longest in the bitch. The cow, ass, sheep, and mare will copulate with fair certainty of success on the ninth day after parturition; the cow not always when sucking a calf; the period may last in the cow not more than twenty-four hours. Experience seems to show that breeding at the second period of oestrum following parturition in the mare is more successful than at the first

period, or as commonly stated on ninth day. From spring till the end of summer the mare manifests a desire for the horse about every twenty-one days, and the announcing signs continue two to four days. The desire is manifested in the cow every three or four weeks and often at closer intervals, and in the sheep and pig it lasts for one or two days, and again appears from the fifteenth to the thirtieth day usually every month during the sexual period. The sow takes the boar about eight weeks after farrowing, and a week after weaning her litter. In the bitch oestrum lasts from nine to fourteen days and during the last seven days only does she take the dog.

## FERTILITY.

The duration of the reproductive period of an animal's existence extends in most cases from the time the individual has almost reached its full size until the beginning of senescence. The age at which animals arrive at puberty is not only different in the various species, but is influenced by the rapidity of their growth and duration of life. Sexual maturity is usually reached later in the male than in the female, and there is no definite ending of the reproductive period, for instance in man the power of producing spermatozoa continues in a diminishing degree even in extreme old age. The ability to generate and produce young, though usually considered as an indicative of adult age, appears before animals have attained their full physical development. The pig may conceive when only four or five months old; the sheep and goat at eight to twelve months; the bitch at seven to ten months; the cow at twelve to eighteen months, and the mare at from one to two years; mares have been known to foal at twenty-two and thirty months of age, and heifers have calved at fourteen, fifteen, and sixteen months of age. The period of puberty is given as commencing in the equine species at from fifteen to eighteen months, in the bovine species at from twelve to fourteen months, in the porcine species at about eight months, and about the same time for the ovine and caprine species, the canine species being a little earlier.

Broadly speaking the average number of young produced in a litter in any species of mammal, is inversely proportional to the average size of the animals belonging to that species. The sow, however, is exceptional in having very large litters, as high as seventeen young being sometimes born. Generally speaking, only one young is produced in those animals in which the period of gestation exceeds six months. The number of teats characteristic of the species also affords an approximate indication of the average size of the litter.

## EFFECT OF AGE ON FERTILITY.

The fecundity of the average mammal of any species may be described as forming a wave, which, starting at sterility rises somewhat rapidly to its highest point, and gradually falls again to sterility. For example, in guinea pigs the size of the litters usually increase with age during the first sixteen months of their lives.

A dog generally has fewer puppies in its first litters than a little later, while in its declining years there is a diminution until sterility is reached once more. With regard to when the ability to produce ceases in animals no reliable data are at hand. Sheep have bred beyond twenty years, the mare after thirty years of age, the cat beyond fourteen years.

## EFFECTS OF ENVIRONMENT AND NUTRITION ON FERTILITY.

That the generative system in animals is peculiarly susceptible to changed conditions of existence has been recognized from an early date. Increased fertility is usually noticed in a favorable environment. The increased fertility in domesticated animals over wild animals of the same species, that is, the fact that they breed oftener and produce larger litters, is attributed to a long habituation to a regular and copious food supply without the labor of seeking for it. Nutrition probably plays the chief part in regulating the capacity to produce offspring in animals which as a rule breed freely under domestication. Not only will an insufficient or unbalanced diet affect this power, but likewise an excessive quantity of nutriment is prejudicial to the proper discharge of the reproductive functions. The amount of sterility among certain of our pampered and overfed pure bred live stock is ample proof of the above statement. Some foods are said to induce sterility more easily than others. Sugar, molasses and linseed meal are noted for having this effect in cattle. Very fat animals do not come in season so often as normal individuals, for in such animals there can be no doubt but that the ovarian metabolism is abnormal, frequently large quantities of lipochrome being found in the interstitial tissue of the ovaries. A low condition, especially if associated with exposure, as in the case of cattle wintered in the open, or of cows which have suckled a large calf, or more than one calf is a common cause of temporary sterility.

While little is known regarding the growth of the Graafian follicle, experimental evidence seems to show that the processes of growth and maturation can be influenced both by insufficiency of food on one hand, and by artificial stimulation on the other. The results derived by flockmasters who have consistently practised "flushing," or artificially stimulating their ewes

by means of an extra supply of food at the approach of the tupping season, would seem to support the above view. Lambing statistics for various flocks of Scottish sheep for the years 1905, 1906, and 1907, show that the percentage of lambs born was, as a rule, highest among sheep subjected to a process of artificial stimulation. The method adopted was to feed the ewes upon turnips, oats, maize, dried grains or other additional foods at the tupping time, and for about three weeks previously, while maintaining them upon grass only, during the greater part of the year. The statistics show that in the flocks treated in the way described there was almost invariably an increase over the average percentage of lambs in flocks which received special treatment, while the percentage of barren ewes was usually also less in the specially fed flocks. In some cases the number of lambs per ewe in the flushed flocks was nearly 200 per cent. Among flocks of the same breed which received no treatment, the average proportion of lambs per ewe was between 150 and 160 per cent, while flocks which were run upon superior pasture at the approach of the sexual season, without otherwise being specially fed, generally produced a slightly larger percentage of lambs. The results must be ascribed to a general increase in the ovarian metabolism, consequent upon the stimulating power of the special food supply. In poorly fed ewes, likewise the sexual season is often retarded, and also the occurrence of some unfavorable climatic condition during tupping time will cause a corresponding scarcity of twin births at the lambing season. Favorable nutritive and environmental conditions tend to promote the more rapid growth and maturation of the follicles in the ovary, and cause a greater number to discharge their ova during the oestrous period.

While it would appear that the female is a far more important factor in determining the number at least, of the offspring, it is obvious that the number of successful services of which the male is capable must depend upon the degree of vigor of the latter. An aged stallion if in good physical condition, will serve from eighty to one hundred and twenty mares in four months with a good average of success. A three year old stallion should be restricted to fifty mares and a two year old to fifteen.

A bull takes sixty to eighty cows and will not be successful with more. Fifty ewes to one ram is about the usual proportion allowed.

## EFFECT OF DRUGS ON FERTILITY.

There is little evidence as to the effect of drugs upon egg or sperm production, but innumerable substances have been rec-

ommended as cures for impotence. Various drugs are said to produce sexual excitement, that is, act as aphrodisiacs, but this result is due probably to irritation; or an increased blood supply to the generative organs. Drugs such as phosphorous, strychnine, alcohol, etc., have been recommended in the treatment of impotence, however the most favorable results have been obtained from the use of yohimbine, an alkaloid obtained from the bark of the yohimbehe tree. A marked increased sexual desire is noticed following its use. Male experimental animals following its administration show erection of the penis and swelling of the testicles and epididymis. Females show swelling of the horns of the uterus, hyperemia of the uterine mucous membrane, a bloody discharge from the vagina, swelling of the vulva and other signs of heat. Pfab, a German investigator, cites the following interesting experience with yohimbine. Out of seventy-nine cases treated for impotence and to produce heat, he secured sixty-two positive results, or an average of 78½%. These animals consisted of two stallions, three bulls, one boar, eight mares, fifty-three cows, and twelve sows. Daels found that yohimbine when administered to dogs produced hyperemia of the generative organs, followed by a uterine discharge, but not true heat. Cramer and Marshall report favorable results from its use in bitches and rabbits. It seems possible that yohimbine by a selective action on the genital organs, thereby preserving a constant and a rich supply of blood, and consequently of nutriment to the ovaries, may tend to influence fertility. There is some positive evidence that yohimbine may promote mammary development and the secretion of milk.

## ARTIFICIAL INSEMINATION.

The act of copulation results in the introduction of seminal fluid through the generative aperture of the female. The introduction of the fluid into the female generative passages is termed insemination, as distinguished from impregnation or fecundation, which are the terms used in reference to the female when actual fertilization, or the uniting of the male cell with the ovum takes place. Artificial insemination merely refers to the placing of the seminal fluid into the generative passages of the female, usually the uterus, by artificial means, i. e., by the use of a syringe or capsules. It is obvious that in those animals which ovulate, that is discharge the unimpregnated ovum from the ovary spontaneously during the oestrous periods, it should be possible to induce pregnancy at such times by the artificial introduction of spermatozoa into the uterus. While it is probably true that maturation processes in many animals take place only as a result of a spe-

cific stimulus which may be induced by the act of copulation, it is also true that in some animals maturation takes place independently of any stimulus, at such time as the follicle has attained a sufficient degree of ripeness. Maturation and ovulation are intimately associated, and the latter like the former, is probably in certain animals dependent for its occurrence upon a definite physiological stimulus. The Graafian follicle may rupture when the ovum has reached a certain degree of maturity, or it may require the additional stimulus of sexual intercourse before ovulation can be induced. Authorities differ as to just how important coition is as regards ovulation in the various animals, or as to the exact time at which it occurs. Experimental evidence would seem to show that in the majority of mammals, coition is not essential to ovulation, but that ovulation occurs spontaneously during "heat" and generally during oestrum and not during proestrum.

### THE SEMINAL FLUID AND SPERMATOZOA.

The semen serves as a mechanical medium in which the spermatozoa move. It is possible that it may have a nutritive function. When ejected, the seminal fluid is mixed with the secretions of the accessory glands the prostate, Cowpers, etc., the functions of which are more or less obscure. The number of spermatozoa existing in normal semen varies greatly. The number diminishes almost to zero after a number of successive emissions and increases again after a few days interval. The number of sperms present in the ejected seminal fluid of the dog was found to be greater at the end of an interval in which there were no emissions, but it did not continue to increase after more than eight or ten days. In a normal emission of semen in man it is calculated that there are about 226,000,000 spermatozoa but that the number may vary from zero to 551,000,000. The average number is given as 60,000 per cubic centimetre. When the spermatozoa are in the testes they are inactive but begin to move rapidly as soon as they are ejected in the seminal fluid. Their rate of movement has been estimated at 3.6 millimetres per minute. They continue to undergo movement as long as they retain their vitality, the rate of movement gradually diminishing and ceasing shortly before death. It is commonly stated that in man the passage of the spermatozoa from the vagina inwards is assisted by a contraction of the muscular wall of the uterus, which compresses the cavity of that organ into which the sperms are drawn when relaxation takes place. The contraction of the uterus is said to be a reflex act resulting from copulation. Heape has shown that in the rabbit the passage of the spermatozoa

into the uterus is probably assisted by a sucking action on the part of the latter organ. The os uteri, which is situated above the ventral wall of the vagina, was observed to dip down into the seminal fluid at the bottom of the vagina and then to be withdrawn again in conjunction with a peristaltic contraction of the uterus. These movements were repeated at intervals. Moreover, it was found that the sucking action could be induced artificially by stimulating the erectile tissue of the vulva. It is probable that the spermatozoa after once entering the uterus proceed to their destination unassisted, and that the direction of their movement is determined by the capacity they possess to respond to the stimuli set up by opposing currents. The vitality of the spermatozoon varies widely in the different species. Living sperms have been found in the internal genital organs of female rabbits eight days after coition. Bonnet states that he has observed motionless but undisintegrated spermatozoa seventeen and one-half days after coition. Strassman has recorded a case in which human spermatozoa survived in the female generative passages for a week after coition. In another case described by Duhrssen, living spermatozoa were found in a woman who stated that coition had not been experienced for three and a half weeks. The spermatozoa of some warm blooded animals will stand considerable variation in temperature and still retain their vitality. They will live for several hours at room temperature, but tend to survive longest at body temperature. Heape states that seminal fluid of the dog was sent him by post, and on being examined eighteen hours after obtained, fully one-half the sperms were active and vigorous. Chechowski in describing artificial insemination in mares states that if the seminal fluid is kept at proper temperature it is possible to keep the sperms alive for twenty hours. Bright light and cold are especially fatal to spermatozoa.

## SIGNIFICANCE OF ARTIFICIAL INSEMINATION IN OVERCOMING STERILITY.

Artificial insemination as a means of overcoming certain forms of sterility particularly in mares has been practiced for many years in America, India and the British Isles. Sterility in mares and cows and other animals is often due to structural or functional defects in the vagina, os uteri, or cervix, also to abnormal vaginal secretions probably acid in reaction, which kill the spermatozoa before they can effect an entrance into the uterus, and in other cases inability of the vagina to retain the semen after coitus. Artificial insemination has been practised on mares with good success and on cows with fair success, in such defects as flexion or constriction of the canal of the

cervix; rigidity of the cervix; hypertrophy of the lips of the external os, the formation of false membranes which may close the orifice, inability to retain the semen in the vagina for various reasons, abnormal structure or size of the cervix or os uteri which may be due to lacerations at a previous parturition, occlusion of the os due to spasmodic contraction of the muscles of the cervix during coitus and immediately after, abnormal or excessive vaginal or uterine secretions, etc., which may deleteriously affect the spermatozoa. Aside from the possibility of overcoming some of the above mentioned causes of sterility by the use of artificial insemination, the economic side of the proposition, i. e., the possibility of breeding a number of mares from one service of the stallion, comes to mind. Relying upon the physiologic fact that only one spermatozoon is necessary for successful fecundation, and that several million are lost at each service, the possibility of artificial insemination becoming an important economic proposition is entirely feasible, not only from the standpoint of a number of impregnations from one service, but also from the standpoint of lessening the opportunity for conveying infectious genital diseases, conserving the virility of the sire and thereby contributing to more vigorous offspring, transporting of semen and making impregnations at a distance, breeding of jennets with stallion semen, producing a hinny, etc., etc.

DEMONSTRATION.

Lecture was followed by a practical demonstration, and discussion of the technique of artificial insemination in mares and cows.

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## Anatomy of the Reproductive Organs

H. S. MURPHEY, AMES, IOWA.

This period was taken up by a lecture following the usual description of these organs and a demonstration upon dissected specimens which were suspended in an upright position to show normal relations.

# Sterility in Cows

H. E. BEMIS, AMES, IOWA.

In presenting this paper we will not be able to give a complete discussion of the many causes of sterility in the cow because we have not had opportunity of observing a sufficiently large number of animals or of making a thorough investigation of the many conditions which present themselves, but rather we hope to present some of the conditions as they have been found in various parts of the state and to give some methods for the prevention for the handling of these conditions. This subject is of great economic importance to the state as sterility is not rare at the present time and it will continue to increase as the dairy and beef breeding industries become more intensive.

In order to be able to reach some conclusions as to the causes of sterility it is necessary that the surgeon first becomes familiar with the anatomy of the female genital organs by study and demonstrations such as you have just had from Dr. Murphey and then become able to determine whether these organs are normal or abnormal in their size or relations by palpation per rectum or by inspection per vaginum. Cows to be examined should preferably be starved out for twelve hours. In preparation for a rectal examination the sphincter muscle of the anus should be weakened by inserting the fingers of the two hands and pulling in opposite directions until the muscles relax and air entering the rectum will cause defecation reflexly. After shortening the finger nails and cleansing the hand and arm as well as the anal and perineal regions, the hand and arm should be thoroughly lubricated with some non-irritating material. For this purpose I regard green soap as being one of the most efficient preparations. The hand should be inserted slowly with rotary movements so as to give plenty of time for relaxation, thus avoiding laceration of the mucous membrane. The hand should be passed in until it reaches just beyond the rectum into the small colon which is comparatively thin walled and gives opportunity for more accurate palpation through it. The hand and arm carrying the intestine with them can then be brought back into the pelvis where the normal uterus will be found lying just below the rectum. The normal uterus should be soft and pliable and small enough that the entire organ can be gathered up in the hand. A little practice will make it possible to distinguish the bifurcation of the horns and to trace each forward, downward, and backward to the fallopian tubes and ovaries which lie close to the body of the uterus, a short distance from the

median plane and just about at the entrance of the pelvis. The finger nails should at all times be kept away from the mucous membrane. In this way the ovaries can be gathered entirely within the hand and pressure put upon them without injury to the walls of the rectum.

The normal ovary of the cow is ovoid in shape, varying in size from 1 to 1½ inches in length and ½ inch to 1 inch in thickness. Its surface is usually lobulated by the presence of follicles which vary in size from 2 to 14 mm. in diameter and by corpora lutea. The true corpus lutem may reach a diameter of 1 to 2 cm., is usually nearly circular in outline, and is deeply imbedded in the ovary so that while it projects from the surface it is more a part of the ovary than the cysts to which we will refer later.

Reinhardt classifies the causes of sterility in cows as follows:

I. Abnormalities in Heat.
   1. Absence of heat.
   2. Decreased heat.
   3. Increased heat.

II. Abnormalities hindering copulation.

III. Abnormalities hindering conception.

IV. Abnormalities hindering development of the embryo.

I. Abnormalities of the Heat.
   1. Intermission of the heat.
      a. General causes.

The absence of heat in cows may be due to a variety of conditions which might be put into two groups, general and local. Among the general conditions are excessive fatness, deep milking, little exercise, high feeding for special purposes, especially upon protein rations. The practice of feeding for excessive fatness or excessive milk production is often seen to be more than can be assimilated without permanent injury to the organs of digestion and elimination as well as those of generation. Again the opposite conditions such as cold, and exposure, or debilitating diseases.

For these conditions, correction of the causative factors, followed by aphrodisiacs such as yohimbin are advised.

B. Diseases of the genital organs.

a. Deformities.

Deformities such as absence or lack of development of the ovaries, tubes, uterus, cervix or vagina are not altogether uncommon in cows.

b. Diseases of the ovaries.

Acute and chronic inflammations, atrophy, schlerosis, tuberculosis, tumors and cysts are all important affections of the ovaries. While any of these conditions may result in the ab-

sence of heat, this is not constant. The diagnosis must rest upon vaginal and rectal exploration. The size, consistency and sensitiveness will give some idea of atrophy, hypertrophy or inflammation. Schlerosis usually results in enlargement of the ovary into a hard, fibrous, nearly rounded and less lobulated body than the normal ovary. Tumors and dermoid cysts result in great enlargement and usually more irregularity in outline. One case in our clinic presented an ovary which was fully the size of a man's fist. Unfortunately there was no opportunity for post mortem, or castration so that an exact diagnosis could be made.

The treatment for this class of cases is largely inadvisable unless but one ovary is affected in which case unilateral castration may restore the animal to breeding.

C. Persistence of the corpus luteum.

The cause of this condition is usually to be found in disease of the uterus following parturition, especially if the uterus retains pus or portions of the membranes, thus establishing a constant source of inflammation which involves the ovary by continuity of tissue. Sometimes the symptoms are only those of intermission of heat and the presence of the corpus luteum which can be easily felt in one or both ovaries; but usually there is an accompanying, or rather a preceding endometritis; the walls of the uterus are heavy, the horns may be assymetrical, the body of the uterus the size of a child's arm or larger, the cervix more open than normal or nearly closed, and the vagina showing inflammation by reason of its color and the discharge of a muco-purulent material which soils the tail and perineal region.

Treatment. If there is merely a persistent corpus luteum, its expulsion is usually all that is necessary. One must be extremely careful that the animal is not pregnant as such treatment would be followed by abortion. Williams reports that the diseased corpus luteum and the corpus luteum of pregnancy may exist side by side in the same ovary. Pregnancy can be determined by handling of the uterus per rectum even as early as six weeks after conception.

The ovary should be kept under pressure of the hand for some minutes after the corpus is dispelled to prevent hemorrhage which has been reported to occur and even to be fatal in some cases. Reinhardt reports that where heat is absent from the mere presence of persistent corpora lutea, heat returns in fourteen days after the operation.

If endometritis or pyometra with retained fluids exists, the diagnosis can be made by palpating the size of the uterus per rectum. In endometritis the uterus is enlarged, elongated, and

thick walled, but is for the most part pelvic in position, while in case of pyometra of any standing the uterus is abdominal in position, is bladder like in shape, and weighed down by the presence of fluid which usually discharges periodically in small amounts. The pregnant uterus can be distinguished from pyometra by the fact that it is chiefly elongated, and broadened, but flattened from above to below and the prominences of the fetus can usually be felt within it. Furthermore, if there is good evidence of a purulent discharge from the uterus, there is no possibility of pregnancy.

Treatment. The treatment of metritis depends upon opening the cervix and removing the abnormal contents of the uterus by irrigation and massage. The method of Albrechtsen for this purpose is especially recommended when inflammation of the cervix is present. The instruments necessary are before you, they are: a speculum, a pair of long forceps for securing the cervix, forceps for dilating the cervix, an Albrechtsen catheter, rubber tubing and a syringe or pump. The animal is secured in the standing position, the external genitals cleansed and the vagina irrigated with an antiseptic solution (3% therapogen). The hands and instruments being sterilized, enter the vagina, grasp the cervix with the forceps and pull it back as far as possible. Cows make little or no resistance to such handling. Insert the speculum and dilate the cervix by introducing the forceps, using rotary movements. Give time for dilatation rather than tearing. When the forceps have entered then the catheter can be introduced and the uterus flushed until all foreign material escapes. In some cases pressure upon the uterus per rectum is of great service. For flushing, 3% therapogen is very satisfactory and pleasing to use where there is considerable odor, though any ordinary antiseptic solution, or tincture of iodine 3% may be used. Follow irrigation with a half dram capsule of iodoform. Albrechtsen irrigates the uterus with 5% alcohol followed by Lugol's solution (1: 3: 97 or even 1: 3: 17). These fluids should be drained away through the catheter to avoid contact with the mucous membrane of the vagina.

If the cervix is enlarged, swollen, overlapped with folds of mucous membrane, or deformed it should be cleansed with dilute alcohol painted with tincture of iodine or superfluous tissue removed with scissors. According to Reinhardt it is not necessary to remove the corpus luteum as heat reappears in three weeks after the successful treatment of the uterus or cervix.

D. Cysts of the ovaries.

Cysts occur in the follicles as well as the corpus luteum. A study of sections of the ovaries made in our anatomical lab-

oratories seems to show that cystic corpora are more common than cystic follicles, and that the presence of the cysts can be foretold from the appearance of the follicular epithelium. This can be readily understood, inasmuch as Reinhardt, Albrechtsen and others regard cysts as being secondary to disease of the uterus. We have had opportunity to watch this process in one case in which it seems there could be no doubt as to the structure first affected. A large healthy Holstein cow had the misfortune to suffer a rupture of the supero-lateral wall of the uterus involving the anterior portion of the cervix. A severe infection followed which lasted for about two weeks but by daily sponging and packing with gauze the part healed, leaving some deformity of the cervix which was otherwise normal. At this time the ovaries were normal. The animal left the hospital and no more attention was given her until breeding season came the following spring when it was found she would not conceive in spite of frequent service. An examination at this time showed the ovaries somewhat enlarged, the left slightly cystic, walls of the uterus heavy, and cervix deformed by scar tissue. Thinking that the trouble might be chiefly mechanical we carried out dilatation of the cervix and artificial impregnation without success. At present, nearly a year from the time of the original accident, the uterus shows moderate endometritis. The cervix is dilated, os overhung with folds of mucous membrane, the left ovary soft and containing a cyst as large as a hen's egg, while the right is firm, lobulated and enlarged. I have no doubt that the changes in the cervix and ovaries resulted from the inflammation of the uterus which was established at the time of the accident.

Symptoms. Cystic ovaries in certain stages seem to cause absence of heat, in others nymphomania which will be discussed later. There may be also relaxation of the pelvic ligaments and lips of the vulva, accompanied by prolapse of the vagina and a slight vaginal discharge.

Treatment. The treatment aside from irrigation of the uterus and treatment of the cervix already discussed, consists in crushing the cysts. The operation is performed through the rectum. The ovary is grasped in the whole hand and pressed or with two fingers pressing it against the thumb or ilium, always being careful to use only the fleshy portions of the end of the fingers. The bursting of the cyst is easily noticed by the collapse of the ovary in the hand. Moderate pressure is all that is necessary except for cysts imbedded in the center of the ovary or old cysts surrounded by inflammatory tissue. In these cases the operation is performed through the vagina. One hand in the rectum brings the ovary to the other in the vagina. If this method is not successful either, the cyst can be emptied

by means of a fine trochar through the wall of the vagina. Here too the ovary is fixed by the one hand in the rectum. The operation is easy and without danger if the ovary is kept under pressure for a few minutes to prevent hemorrhage. Reinhardt reports return to normal in 60 to 80% of cases, and these figures have been borne out by my own experience when the chief trouble has been the presence of the cyst unaccompanied by severe metritis or vaginitis.

E. Diseases of the Fallopian tubes.

Catarrh, purulent inflammation and edema of the Fallopian tubes undoubtedly exist, and when aggravated, can be diagnosed by palpation per rectum but their treatment is scarcely possible because of their inaccessibility.

F. Diseases of the uterus and cervix.

From our observations upon nearly one hundred cases of sterility in cows within the state, the most important diseases of the uterus and cervix are endometritis or a chronic inflammation within the walls of the uterus, and cervix, and pyometra or pus within the cavity of the uterus. Both of these are usually accompanied by inflammation of the vagina and ovaries as already indicated.

The causes of these conditions are undoubtedly many but the two diseases that seem to be responsible in most cases are infectious granular vaginitis and contagious abortion. The former disease which has been investigated in Europe by Hess, Zschokke, and Ostertag and in this country by Dr. Williams, is wide spread and affects young animals as well as others. All of the herds observed in this state have shown the disease in over 50% of the animals. Fortunately only a small per cent of those affected become sterile. The cause of the disease according to Ostertag is a streptococcus which is transmitted most readily by coition but may be transmitted through contact with diseased animals or contaminated bedding.

"The disease commences with a moderate swelling of the vulva, and a diffuse spotted, or streaked reddening, further swelling, formation of folds and increased sensitiveness of the vaginal mucous membrane, when a muco-purulent secretion collects on the surface. In one to two days millet seed sized, smooth nodules at first dark red appear on the mucous membrane of the vestibule of the vagina, especially on the clitoris and folds of the prepuce. Simultaneously with the appearance of the nodules, a vaginal discharge appears in the majority of the cases, which is first scanty, later more profuse, glassy, tenacious, and sometimes muco-purulent. The general health is usually undisturbed. The course is protracted, the symptoms remaining for two or three months or longer."

Treatment. "One of the most important requirements for satisfactory results consist in cleanliness, disinfection, and painstaking care of the stables, also in the careful supervision of copulation, in order not to hinder the healing process by reinfection." (Hutyra & Marek.)

For local treatment the external genitals should be washed daily with antiseptic solutions and the vagina irrigated with mild antiseptics such as 3% therapogen followed once or twice a week with 3% Lugol's solution. As the condition improves, irrigate less frequently, and do not allow service until the discharge ceases.

Contagious abortion while not uncommon in this state seems limited to certain localities. Probably all established herds have cows which occasionally abort, and so far as I have observed, all established herds have cows affected with contagious granular vaginitis which abort and retain the fetal membranes. Whether there is any relation between the two diseases as suggested by some, I would not attempt to say but I think we can say that both may lead to vaginitis, metritis, and cystic ovaries resulting in sterility.

Pyometra results from the introduction and retention of infection within the uterus either following parturition and retention of membranes or following uncleanly operations, etc. Both of these conditions endometritis and pyometra, may lead to inflammation of the cervix but primary affections of the cervix aside from injuries are rare.

Treatment of diseases of the uterus and cervix.

The treatment has already been outlined under the discussion of persistent corpora lutea.

2. Anaphrodisia. (Decreased heat.)

Causes: Reduced heat may be caused by innutritious diet, over work, debilitating diseases, or natural inclination.

Treatment: Correct the conditions and use aphrodisiacs, watching closely for signs of heat and breeding only at such time.

3. Nymphomania. (Increased heat.)

Causes: Old cows and cows kept closely confined in stables producing a large amount of milk are especially apt to suffer. Ovarian cysts especially when large and tense, inflammation of the tubes, uterus or vagina, vulva and clitoris may also cause this condition.

Symptoms: Aside from the increase or irregularity in heat, such animals usually show relaxation of the sacro sciatic ligaments, vulva and vagina, prolapse of the vagina, decrease in milk production and lack of condition.

Treatment: Pressing out the cysts is of primary importance in these cases. That relief is afforded is evidenced by the fact that shortly after such operation the animals return to normal behavior, increase in appetite and milk flow. Though the cysts may return again in a few weeks, the majority of these cases can be returned to breeding service if attended regularly. I have succeeded in returning animals which have been sterile for a period of two years. Care must be taken always to determine that the animal is not pregnant before massaging the ovaries as cows so affected may show heat and take service at any time during the period of pregnancy and if the corpus luteum should be expelled, abortion would probably result.

II. Abnormalities hindering copulation.

1. Mechanical obstructions such as atresia of the vagina: persistent hymen, tumors, cysts of the vagina, etc. These are usually easily recognized and their treatment carried out accordingly.

2. Hindrances of nervous origin. Young cows, especially Jerseys and Guernseys are apt to be very excitable and nervous which some times results in vaginismus or contraction of the vagina which leads to expulsion of the semen and consequent sterility. Such animals should be carefully handled under natural surroundings and bred to males of which they are not afraid. Some advise sedatives.

III. Abnormalities which hinder conception.

In this class are many conditions which only occasionally result in sterility such as closure of the os uteri, the presence of acid mucous secretions, breeding too late in the estrual period, tumors in the uterus and hypertrophy of the corpus luteum of estrum.

Treatment. In regard to closure of the os and cervix in cows aside from cicatricial contraction, I am fully in accord with Dr. Williams who contends that it is not an important cause of sterility, and it should not be opened except for treatment of pathological conditions in it or the uterus beyond it.

Acid secretions may be neutralized by the use of 1% bicarbonate of soda solutions.

I believe, however, that cases of hypertrophy of the corpus luteum of estrum are frequent as our records show a number of animals having nothing abnormal except hypertrophied corpora. These animals breed regularly but fail to conceive. The ovaries should be massaged repeatedly until they remain normal before allowing service.

IV. Abnormalities which hinder development of the fetus.

In this class abortions either sporadic or infectious are the most important but as they take us away from the primary object of this paper they will not be discussed here.

From the foregoing, I should like to conclude that there are many conditions which cause a small per cent of cases of sterility such as congenital conditions, feeding and management problems, tumors, cystic and hypertrophied corpora lutea and follicles apparently unaccompanied by primary conditions, but that the important class includes inflammations of the vagina, cervix and uterus with their complications. The two diseases that seem responsible for a great majority of such inflammations are infections granular vaginitis and contagious abortion, followed by retention of the fetal membranes.

In the preparation of this paper I am indebted to Dr. Murphey for the study and interpretation of a large number of sections prepared for histological study, to Mr. F. W. Fox, and A. R. Stephenson, technicians, and to Dr. Wehrbein for his excellent translation of Reinhardt's discussion of sterility in Harm's "Lehrbuch der tierarztlichen Geburtshilfe."

# Foot and Mouth Disease

C. H. STANGE, AMES, IOWA.

Foot and mouth disease is classified and defined as an acute febrile, contagious, infectious disease of cloven hoofed animals during the course of which vesicular examthenia develops in the mouth and between the digits.

Historical.—Most of the records of foot and mouth disease outbreaks come from Europe. To Europe the disease like other serious animal plagues probably came from the east. In all probability it has been more or less prevalent in Europe for hundreds of years but it is usually difficult from accounts in old-world writings to distinguish the different diseases as we recognize them at the present time. It is very probable that all contagious infectious diseases of particular species of domesticated animals were more or less confused. Records indicate that Sagar recognized the contagious character of the disease as early as 1764, but the cause until the last half of the past century was sought in connection with atmospheric and climatic conditions, decayed food, etc.

The United Kingdom records its first authentic outbreak in 1839. This was followed by twelve others, the last being maintained in 1913. Austria was not free from foot and mouth disease for thirty years following 1878. Moravia has had the disease since 1878, perhaps longer. Germany records outbreaks of unusual severity during 1812 and 1819-1823. The whole of Europe suffered severely during the years 1845-1846 and 1855-1857. Rapid spread is recorded in 1862, 1869, 1871-1874, 1875-1877 and 1883-1884. Since the adoption of the Imperial law for the control of animal diseases the disease has succeeded in spreading during the years 1890-1892, 1896-1899 and 1911-1912.

The United States has experienced six outbreaks, viz: 1870, 1880, 1884, 1902, 1908 and 1914. The first (1870) outbreaks came from Scotland by way of Canada where it was brought by imported stock. It extended into the New England states and New York, but was checked in a few months. Limited traffic in live stock and in frequent travelling made conditions favorable for its eradication. The outbreaks in 1880 and 1884 were easily controlled as there was little spread in one case, and none in the other from the original animals brought in. The Bureau of Animal Industry calls attention to the fact that the early outbreaks were caused by infected imported animals but since adopting the present system of inspection and quarantine, live animals have not been a factor in its introduction.

The 1902 outbreak was traced to near the docks at Chelsea, Mass., and it was thought that foreign importations of animal products, etc., has been responsible but later developments have led the federal authorities to suspect cowpox vaccine virus imported from Japan as being responsible. Two hundred and forty-four herds of 4,712 cattle were infected. Two hundred and five herds of 3,872 cattle and three hundred and sixty hogs and two hundred and twenty sheep were slaughtered. Some of the cattle not slaughtered died while the remainder had completely recovered before slaughter took place. The total cost to the United States Department of Agriculture of stamping out this outbreak was $300,000, $178,908.57 of which was paid as 70% of the value of animals slaughtered.

The 1908 outbreak was first discovered near Danville, Pa., and was traced to Detroit, Mich. Four states were involved, Michigan, New York, Pennsylvania, and Maryland. Calves used in the manufacture of vaccine virus were responsible. The vaccine virus had been imported from Japan and was contaminated. The disease was eradicated in five months at an expense of about $300,000 to the Federal Department of Agriculture, and $113,000 to the states. One hundred and fifty-seven farms were infected, and 3,636 animals were slaughtered.

The last appearance of the disease in the United States was near Niles, Michigan in October, 1914, apparently having been present however, as early as August. Since that time the disease spread to twenty-one states and the District of Columbia, and from the Atlantic to the Pacific Ocean. Illinois was most seriously involved. In Iowa 9 counties were infected, including 3,911 animals and one-half of the appraised value of the stock paid by the state was $..... The figures for the United States are not yet available as two new centers of infection have developed, one in Illinois, and one in New York.

*Occurrence.*—The tendency of the disease is to spread over large areas from time to time affecting especially cattle, but also sheep and swine. Previous to the enforcement of rigid regulations, the disease would spread over the entire European Continent in 2-4 years. Naturally it spreads most rapidly when traffic in live stock is most active.

The agricultural significance of foot and mouth disease is difficult to estimate. It must be considered as one of the most serious animal plagues, not on account of its high mortality which is usually placed at 1-5%, but because it interferes with commerce and trade in animals; it necessarily causes the closure of fairs and markets; it interferes with the supply of meat and milk; exports are impossible and interstate com-

merce in live stock and animal products is at a stand still. The mortality may, however, reach 30-40% in the malignant form which is occasionally reported in foreign countries. In addition, there is rapid loss of condition and milk secretion with abortion in pregnant animals. The latter items often amount to 20-30% of the value of the Live Stock which does not include the cost of controlling and eradicating the disease.

*Etiology.*—The cause of this much dreaded disease is classified as a filterable virus. By a filterable virus we mean an agent that possesses the power of passing through porous filters (porcelain) which are capable of preventing the passage of the visible bacteria. Hog cholera virus is one of our most familiar examples. The viruses known at present to produce disease in man and animals, with our present facilities are beyond the limits of visibility with the microscope. The idea of invisibility may disappear with new methods and greater facilities; they should therefore be referred to as filterable viruses. The phenomena of filtration is extremely complex. It depends not only on the porosity of the filter, but also upon the size of the particles, their motility; the degree of dilution, the albuminous content of the liquid; the pressure, the temperature, the duration of the process, etc. The filterable viruses are not necessarily invisible. The organism of pleuro-pneumonia is cited as an example. The tendency in diseases caused by filterable viruses is to develop epithelial lesions. These Borrel has grouped as "Epitheliaises." As a rule viruses have a specific character and with a few exceptions are pathogenic for only a single species. In foot and mouth disease, only cloven hoofed animals are affected. Viruses are strictly pathogenic some being transmitted directly, others through an intermediary host. Their geographical distribution is very wide, and they spread with the greatest ease. except where an intermediate host is required. The invasion of the body by filterable viruses predisposes it to secondary infections which may cause severe disturbances and obscure the symptoms of the primary infection. Their pathogenic property usually persists even in the very high dilution. The phenomena of immunization in diseases due to a filterable virus do not appear to resemble those in the bacterial diseases. An antibody is rarely found which is capable of acting upon the virus in vitro except as regards the fixation of specific substances present in the serum. Vaccination and sero-vaccination appear to give the best results. Certain may persist in a latent condition in animals previously infected. These carriers of latent infection, which apparently are in perfect health, may excrete the virus and form fresh centers of infection.

While a number of other organisms have been isolated and cultivated it is generally agreed that the etiological factor of foot and mouth disease belongs to the filterable virus group, the general characteristics of which have just been enumerated. The cause of foot and mouth disease has therefore neither been seen nor cultivated. The virus is present in the lymph from the vesicles and during the period of incubation and at the time of development of the symptoms and lesions the virus is in the blood; it soon disappears, however, on the appearance of symptoms. The saliva, lachrymal fluid, nasal discharge, milk and other secretions become infectious by being mixed with contents of ruptured vesicles. The virulence of lymph from the vesicles is said to decrease and usually it loses its infectious qualities at about the end of ten days from the onset of the disease.

*Resistance*—Drying at room temperature by daylight destroys the virulence in 24 hours. Diluted virus in hermetically sealed tubes however will remain virulent for 3-4 months. A temperature of 37.5° c. will destroy it in 12-24 hours; 70° c. in 10 minutes and boiling destroys it immediately. It is destroyed in one hour by lime water, 1% phenol, 2% formalin. Souring of milk is said to destroy its infectiousness. In manure the virus apparently does not live long—not more than a week; the temperature which the manure reaches on heating is sufficiently high to destroy the virus. It probably does not live long in the soil being destroyed by sunlight and dessication.

Professor Mettam of the Royal Veterinary College at Dublin claims evidence of infection by a fleece eighty-six days after the fleece had been removed from the body. The vitality must be greater than generally supposed and Professor Bang cites outbreaks in Denmark showing that the virulence may persist for 12 months or more.

The pathogenic properties of fresh virus are great and the intra-venous infection of 1-5000 of a cubic centimeter has produced the disease in susceptible cattle. Lymph applied to the slightly scarified oral mucus membrane to the conjunctiva rectum or vagina. intramus cular, produces the disease. Also lymph saturated cotton placed in the mouth and feeding of virus is often successful. On the other hand, subcutaneous injections are uncertain. Virus from sick hogs appears unusually virulent.

Natural infection often follows direct contact, diseased animals coming in contact with healthy ones in stables, stock markets. in pastures, shows, etc. Infection through respired air has not been demonstrated. The indirect infection has a much greater significance in this disease. For example, when

infectious saliva contaminates food, mangers, fences, drinking water, litter, pastures, driveways, railway cars, the hands and clothing of attendants, the opportunities for transmitting the infection are afforded. The most dangerous sources, therefore, are when diseased animals are driven, transported by railways, placed in stables, watered, pastured or taken to market. In the second place, the food, manure and raw animal products as hides, wool and milk must be considered; also all persons and animals not susceptible but coming from infected premises are dangerous. Very important factors are stock markets and stock buyers when the latter are passing from farm to farm.

Uninformed veterinarians should not be excluded from this list. The transmission by contaminated vaccine lymph has already been referred to. Whether flies are capable and do transmit the disease has not been determined. The possibility of recovered animals being apparently healthy and still excreting the virus and thus acting as centers of infection is of great significance and seems to be responsible for a number of outbreaks recorded in foreign countries. Calves and hogs are very frequently infected through milk from diseased animals and often a creamery will infect a large number of farms. Horses, dogs and cats are said to become infected very seldom.

The period of incubation varies somewhat but is usually two to seven days, rarely more than eleven. Febrile symptoms most marked in young, vigorous animals, often unnoticed in older animals is the first symptom. The temperature drops rapidly to normal as soon as vesicles form and remains normal except where there are septic complications. The rise in temperature is usually accompanied by some depression of appetite. Further symptoms depend on the localization of the disease.

The affection of the mouth is most frequently seen in cattle. The painful condition of the mucus membrane leads to slow, careful, mastication and slow deglutition. Between feeding periods the mouth is kept closed as much as possible and it is opened occasionally with a characteristic smacking sound. The patients present a dull, expressionless appearance, and are not inclined to move unnecessarily while the saliva runs from the mouth in long, ropy, strings. On opening the mouth the accumulated saliva is discharged in considerable quantities. The mucus membrane of the mouth is warm and red. Usually about the second or third day vesicles the size of hemp seed or peas appear in the mouth. The favorite location for these is the borders and dorsum of the tongue especially near the tip, inside of the cheeks, on the gums and inner surface of the lips. The vesicles contain a yellowish lymph and increase in size to that of an egg where the epithelium is thick, as the disease pro-

gresses. These vesicles rupture leaving very red, moist painful shallow erosions surrounded by irregular remnants of epithelium. These erosions are usually covered in a few days by new epithelium but a yellowish brown discoloration remains. The appetite soon returns after the erosions have healed. A proliferation of epithelium without the formation of vesicles is described in certain outbreaks especially in Russia.

Vesicles similar to those described above frequently form on the muzzle of cattle and snout of hogs. Rarely do vesicles form in the nasal cavities and on the conjunctiva. The disease process may also extend to the pharynx.

The affection of the feet is very common in sheep and swine and in cattle usually appears soon after or at the same time as the lesions in the mouth. On account of the pain one of the first symptoms is usually lameness or a stiff gait. This is more noticeable on hard ground and where the feet are extensively involved, the animals lie most of the time. Swine are frequently seen to hold alternate limbs in a flexed position.

Careful examination reveals at first a swollen, painful, condition of the coronet, ball and interdigital space. Following this, vesicles very similar to those in the mouth appear. These may also appear at the base of the accessory digits. After rupturing, the soiling soon leads to the formation of scabs. If extensive exudation occurs under the horn the hoof may be cast off.

The udder is very frequently affected in cows and usually appears simultaneously with the symptoms in the mouth. As a rule the vesicles form on the teats. If the vesicles become large, the entire udder generally swells and the vesicles are usually ruptured during the process of milking. Healing usually takes place under a scab. Quite often a catarrhal condition of the milk wells and canals develops and the milk which is greatly decreased in all cases assumes more or less the characteristics of colostrum, is therefore yellowish, ropy, rancid or bitter, coagulates easily and the reaction is acid. Occasionally it is watery and contains lumps.

Complications in the form of extension to tissues not ordinarily involved, secondary infection leading to deep ulceration in the mouth, abscesses about the feet or in the udder and even septicemia and pyena occasionally occur. Young animals may die of acute gastro-enteritis.

The course in favorable cases is usually five to six days, but may be two to three weeks.

Differential diagnosis is of the greatest significance in the first herds to become infected as early recognition of the disease is of prime importance in preventing extensive outbreaks.

Among the conditions that may be confused with foot and mouth disease are:

Traumatic injuries of the mouth which occur quite frequently on the inner surface of the lips. In these cases, however, the loss of tissue presents sharp, well defined borders, are usually linear in outline and extend into the deeper structures. Pox leads to the formation of pustules, while foot and mouth disease is never more than a vesicle and innoculations with pox do not lead to eruptions for at least ten days or longer.

Necrotic stomatisis does not spread rapidly to the entire herd as well as hogs and sheep. Vesicles are never formed but there is formation of yellowish cheesy material involving the mucus membrane of the tongue and cheeks especially.

In mycotic stomatisis a croupous membrane forms which can be removed quite readily, leaving a red surface. The interdigital space may also be involved. Few if any vesicles form and they do not spread rapidly. Mycotic stomatisis occurs especially during late summer and fall.

The lesion in foot and mouth disease is due to the exuding of lymph into and between the cells of the deep layers of epithelium. The cells are separated and the superimposed layers are raised. The more lymph there is exuded the larger the vesicle. If the lymph spreads in the deep layers of cells, large areas become involved and during examination frequently large areas are removed in attempting to hold the tongue. It is evident that a vesicle with a thin epithelial wall would not persist long. Naturally, inasmuch as the epithelium is not entirely lost, it is soon regenerated and the erosion soon heals.

Mettam regards the following points of primary importance in arriving at a diagnosis.

(1) History of the outbreak, especially its epizootiology.

(2) The characters of the lesions.

(3) The situations of the lesions, not in one animal, but generally in all affected.

(4) The presence of infection in other animals of the farm, especially sheep and swine.

(5) The incubative period, though important, is of less value on account of its variation.

Mereg describes a vesicular stomatitis in cattle presumably due to a fungus. There was an eruption of vesicles in the mouth, sometimes as large as a pea. These were followed by ulceration. The ulcers were deep and irregular with inverted edges bleeding readily and healing slowly. The animals fed normally and salivation was absent. It was not transmissible.

A disease resembling foot and mouth disease more closely is reported by Ostertag and Bugge. It was also reported by Hess at Baden Baden.

*Control—Immunization.* The chief work along this line has been done by Dr. Loeffler. Dr. Nevermann reported on four series of experiments at the Tenth International Veterinary Congress at London. These were conducted by Dr. Loeffler. The first series was conducted with small doses of immune serum. The second to determine its curative properties in severe cases. The third series to determine the protective value of large doses and fourth, the practicability of using the serum as used in the second series under practical conditions. Small doses did not prove satisfactory, but larger doses seemed to have a beneficial influence on severe cases. In large doses the serum rendered sufficient immunity to be of practical value and made it possible to use less rigid quarantine measures.

Professor Mettam says, "It must be admitted that serum therapy, so far as foot and mouth disease is concerned, is not upon a satisfactory basis. The amount of serum required is large and is costly, its action, as with other sera is of short duration."

Professor Leclainche of Paris says, "Up to the present, attempts to immunize animals against foot and mouth disease have not yielded any results capable of practical application." Experiments carried out in France in which repeated injections of forty to fifty c c of serum were administered, show that these doses only exceptionally confer any immunity. The use of large doses is hindered by considerable practical difficulties, and it would be too expensive.

The following report by Dr. Rudovsky of Austria is of interest in connection with the question of immunity. In 1910-1912 he observed that the disease broke out twice on one hundred and twenty-two farms, three times on twenty-two, four times on eight, five times on three and six and seven times on one farm each. In practically half the cases the second outbreak was observed from nine to thirteen months after the first. On twenty-nine farms eight hundred and twenty-nine animals were attacked for the second time from three to nineteen months after the first outbreak, and on the three farms, eighty-five animals were attacked for the third time from eight to twelve months after the second outbreak.

On the other hand, on seventy farms where the disease broke out for a second time, 3,600 animals which had been affected from one to nineteen months previously remained healthy. In a third outbreak on seven farms five hundred and twenty-two animals which had passed through an outbreak from two to

eleven months previously remained healthy. The probability of the animals acquiring immunity after once recovering from the disease is about 81 per cent.

It is of interest to note that all cloven hoofed animals exhibited at Expositions at Strassburg and Hanover were required to have administered a protective dose of immune serum.

*Quarantine and Slaughter*—In this connection Dr. Nevermann suggests that:

(1) The slaughter of infected herds has proved to be an advantageous method of fighting the disease under certain conditions.

(2) Rigid restrictions, such as are laid down by the Prussian regulations, as a rule suffice to prevent the spread of the disease from places where it has broken out. An extensive veterinary and police service is essential for the thorough administration of such restrictions.

(3) No results are to be expected from half-hearted measures against foot and mouth disease.

The quarantine regulations referred to may be summarized as follows:

The quarantined area usually consists of the infected community or township. In the area all cloven hoofed animals on infected premises must be kept in stables. On non-infected premises the cloven hoofed animals must be kept separate. Under conditions existing in Germany, it is usually impossible to control the disease without the stable confinement. Exceptions are made when conditions are especially favorable.

Depending on the danger and local conditions as a rule a zone surrounding the quarantine area is placed under observation. No cloven hoofed animals may be removed from this zone without permission. No cloven hoofed animals are permitted to be driven through this zone. Animals may be removed for slaughter under certain restrictions. Animals to be removed for other purposes must be kept under careful observation for at least a week. The common use of pastures and drinking places by animals from different farms may be forbidden and when deemed necessary all dogs must be kept chained.

The regulations in this observation zone affects chiefly persons with healthy animals and in healthy communities; they are therefore found drastic. In some cases there comes in addition a depression of the price paid for stock by the dealers and no satisfactory method of controlling this has been found.

The arrangement for this observatory zone is severely criticised in agricultural circles and repeated attempts have been

made to dispense with it; according to past experiences it is not possible. It is a mistake to outline this zone by drawing a circle on the map; but it must be outlined on the basis of danger and local conditions.

In the quarantined area of usually at least fifteen kin (about ten miles) determined by local conditions the following additional restrictions are enforced.

(a) Discontinuation of cattle markets except for slaughter in stock yards for food animals.

(b) Stock buying of cloven hoofed animals.

(c) Holding of sales of cloven hoofed animals.

(d) Holding of shows with cloven hoofed animals.

(e) Giving away insufficiently heated milk by creameries and milk stations.

The question arises what has been accomplished by these stringent regulations? Where the regulations were rigidly enforced, the disease was restricted to the original herd. In order to be successful it is absolutely necessary to have sufficient veterinary assistance and police powers. Nevermann points out that if this is not the case the regulations remain only on paper. This failure cannot be attributed to the regulations but to a lack of enforcement.

Foot and mouth disease was quite widespread in Germany in 1910 to 1912 and this has frequently been referred to as a failure of the regulations. To the critics of the methods pursued in the United States it should be pointed out that the disease was well under control until early in 1911 when pressure on the part of agricultural interests necessitated a modification of the regulations. Only infected and adjacent farms were quarantined. Animals were allowed to go to pasture and in a few months over 20,000 premises were infected. The chart shows the rapid increase. The disease is said to have appeared three and four tims in some herds. Nevermann concludes by saying that only rigid, comprehensive, carefully controlled quarantine measures can succeed against foot and mouth disease.

Professor Leclainche says, "The two zone" system permits of closer application of the regulations on farms included within the infected area and of widening the area.

The stamping out method followed by the United States with reimbursement of the owner for animals slaughtered seems the most advisable method under our conditions where the disease is only occasionally introduced. Dr. Remmelts of the Netherlands says, "Preference must by far be given to the immediate clearing of virus by slaughtering diseased and suspected ani-

mals, than to any other measure. Further, it is absolutely necessary that the execution of the measures are not to be entrusted to the different local authorities, but be put into the hands of one authority only. Measures therefore, which are based on voluntary co-operation of the cattle owners and dealers in general are doomed to failure.'' He adds that the cattle owner must be forced to do his duty by severe punishment. His fear for the measures ought to be lessened by giving him a proper indemnification.

Thus it may be seen that our authorities have been in accord with the opinions of the leading men of the world on the control of foot and mouth disease.

The procedure that has been followed is to immediately quarantine any state where the disease appears. State authorities then proceed to quarantine the infected premises and as much area surrounding as may be deemed necessary. A quarantined area is defined as :Any state or portion thereof quarantined for foot and mouth disease in live stock.

When proper quarantine measures have been adopted, the herd is appraised and slaughtered at the expense of the state and Federal government. The premises are then thoroughly disinfected and a careful examination is made of all herds in the quarantined area. The quarantine is gradually removed and passes successively through the following stages.

(1) Closed area: Those portions of the quarantined area into which the interstate movement of cattle, sheep, other ruminants, and swine is permitted, for immediate slaughter only, and from which the interstate and foreign movement of such animals is absolutely prohibited, and the movement of the dressed carcasses of such animals, the hides, skins, wool, hair, horns, or hoofs of such animals, and of hay, straw, similar fodder, manure, litter, or bags or similar containers used for stock feed is restricted.

(2) Exposed area: Those portions of the quarantined area from which the interstate movement of cattle, sheep, other ruminants, and swine is permitted for immediate slaughter after inspection and certification, and into which such animals may be moved for any purpose, also from which the interstate and foreign movement of the dressed carcasses of such animals, and of hay, straw, or similar fodder, manure, litter, or bags, or similar containers used for stock feed is restricted.

(3) Modified area: Those portions of the quarantined area from which the interstate movement of cattle, sheep, other ruminants, and swine is permitted for immediate slaughter without inspection, to points in the quarantined area, and into which

such animals may be moved for any purpose, also from which the interstate and foreign movement of the dressed carcasses of such animals, the hides, skins, wool, hair, and hoofs of such animals, and of hay, straw, or similar fodder, manure, litter, or bags or similar containers used for stock feed is permitted without any restrictions whatever.

(4) Restricted area: Those portions of the quarantined area from which the interstate and foreign movement of cattle, sheep, other ruminants, and swine is permitted for immediate slaughter to points in the free and closed areas, or for any purpose to any point in the quarantined area other than in the closed area, and into which such animals may be moved for any purpose; also from which the interstate and foreign movement of the dressed carcasses of such animals, the hides, skins, wool, hair, and hoofs of such animals, and of hay, straw, or similar fodder, manure, litter, or bags or similar containers used for stock feed, is permitted without any restrictions whatever.

(5) Free area: Those states or portions thereof which are not quarantined for foot-and-mouth disease.

In conclusion it should be emphasized that all veterinarians should consider it their duty to be able to diagnose foot and mouth disease and any indications of the disease should be promptly reported to the proper sanitary officer of the state.

## REFERENCES.

Maul und Klauenseuche. Dr. L. Nevermann, Berlin.

The Struggle against Foot and Mouth Disease, Dr. H. Remmelts, The Hague.

Maul und Klauenseuche. Josef Rudovsky, Brunn.

Foot and Mouth Disease, A. E. Mettam, Dublin.

La Fievre aphteuse, E. Leclainche, Paris.

Les Virus Ultra-microscopiques, Prof. Panisset, Lyons.

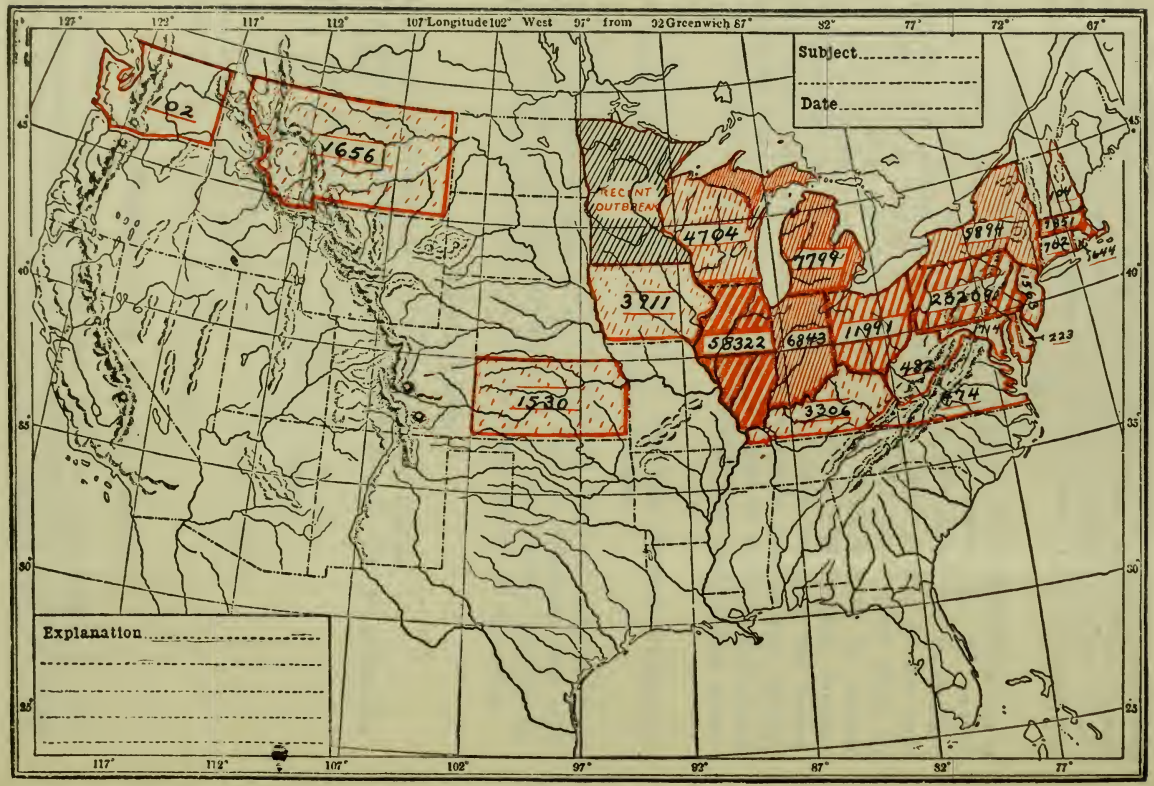
Hutyra and Marek, 4th edition.

Bulletin 666, Bureau of Animal Industry.

## DISCUSSION OF DR. STANGE'S PAPER.

Question: Is it a fact that when they let the animals go out of quarantine that some of them might retain the virus in their systems for say six months and then have another attack at that time?

Dr. Stange: That has been reported a great many times from Europe, where animals were apparently recovered and released, but proved to be carriers.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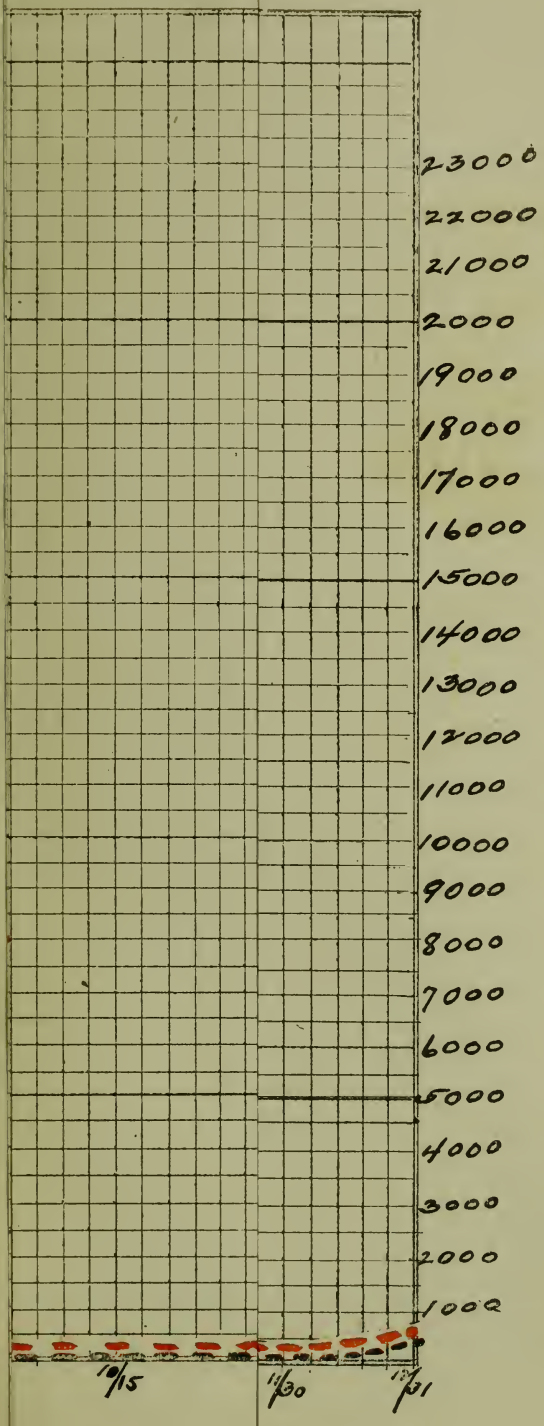
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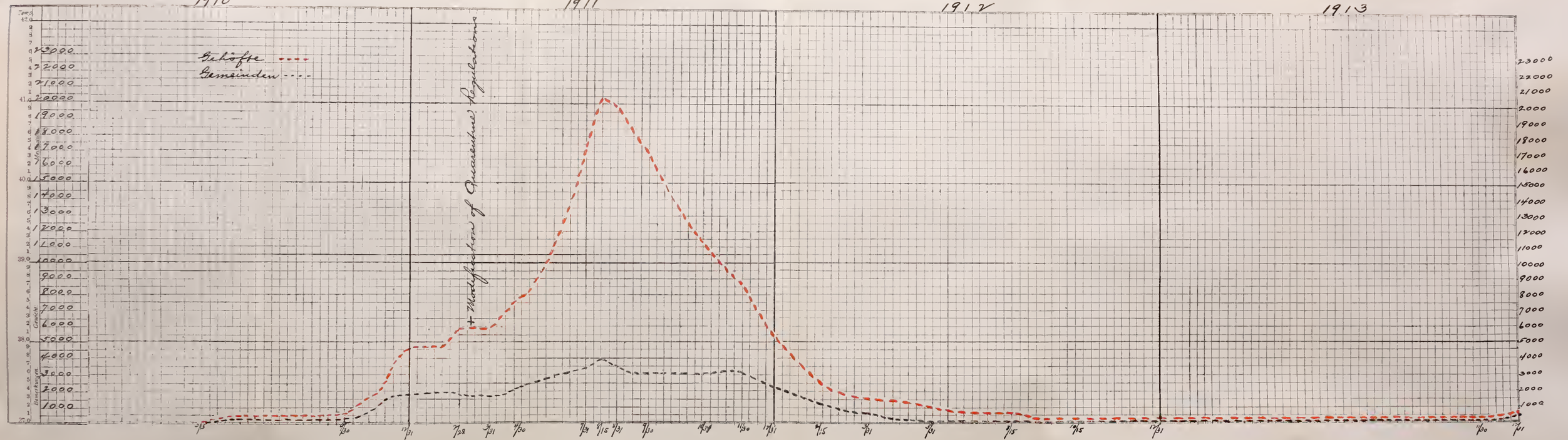
Prevalence of Foot and Mouth Disease in Prussia.



Question: We know them in humans as "Typhoid Marys."

Dr. Stange: Yes, we have typhoid Marys. I think the first authentic outbreaks of typhoid fever they were unable to trace the source, and finally they found a servant that was harboring typhoid germs and giving them off, and thus was responsible for these epidemics, and as her name was Mary they called her "Typhoid Mary," and now when they find a person who distributes infection they are called "Typhoid Mary."

Question: How about the mistakes in distributing hog cholera virus in the recent outbreak?

Dr. Stange: I could not give you much information. The other serum company that is located in one of these cities wrote and told us that the other company had some serum that was bought up by the government at the beginning of the foot and mouth disease outbreak in the yards, and that this serum was released recently and accounted for these outbreaks, that this firm thought they ought to be permitted to ship as the thing was not serious, only ten or twelve herds being infected. You can get from that the attitude of some of the serum producers. They try to minimize the thing as much as possible. We regard it as rather serious. They claim it was the serum that was released, and one of them told Senator Kenyon that they had positive evidence that foot and mouth disease was caused through hog cholera serum. I think the veterinarians ought to know this so they can be careful in regard to hog cholera serum. I am not telling you where to buy your serum, but I would advise you to buy it as far as possible from any outbreak of foot and mouth disease.

# Wound Infection

CHAS. MURRAY, AMES, IOWA.

Entrance of micro-organisms into wounds may be from the surface covering, which harbors a varied flora, particularly organisms of the pus producing group, from the object producing the wound, from faeces, and from the soil. Infection from within, that is, through the blood stream is, of course, more rare.

Infection, as the term is used, is of two-fold significance. Literally, according to the view of the bacteriologist, any tissue containing bacteria is infected, but since it is probable that few wounds, either operative or accidental, are made into which bacteria do not gain entrance from the hands, the tissue surface, unclean objects, such as dressings, or from dust in the atmosphere, and since even under these conditions many wounds still show no signs of infection it is evident the surgeon has an entirely different conception of what constitutes infection. It can be demonstrated that even with the most exacting care it is impossible for the surgeon to completely sterilize his hands, and it is known that in many cases the operator is compelled to work in an already infected field, yet the wound is not contaminated. Absence of infection in such cases is a term used relatively and means either that no bacteria are present, or if they be present are in quantities too small to produce inflammation.

Infection from the surgeon's viewpoint then, means that a sufficiently large number of bacteria is present to affect the tissues. This varies with different bacteria. For some the tissues offer but little resistance. Fortunately this class rarely gains admittance. Another species may enter and be destroyed without causing any tissue changes or producing any pus. The degree of virulence or of attenuation of the bacteria will determine whether given bacteria in a given dosage will produce infection. The result of introduction of bacteria into a wound is largely determined by local and constitutional conditions present. Low vitality due to exhaustion, to disease, or to hemorrhage, may result in serious infection upon the introduction of organisms in quantity that under normal conditions would be disposed of without manifestation of symptoms. Parts of the body containing a rich blood supply will resist infection that in other parts would lead to serious results. The presence of blood clots and of non-absorbable suture material may act to favor infection which in the absence of such would not occur. Bruised tissues, tight banadaging or other conditions which interfere with free blood circulation may result in infection of parts which normally would resist the action of bacteria present.

The constant presence of bacteria upon some parts of the body suggests to us a natural resistance due possibly to the presence of protective substances which antagonize bacteria. Epithelium furnishes a natural barrier to micro-organisms. As long as it remains intact there is slight opportunity for infection. If, however, the epithelium permits the entrance of organisms there is yet some resistance offered to their spread. Whenever insoluble toxic substances gain admission to the mucosa or corium of the skin, large numbers of leucocytes migrate to the point of attack and together with the fibroblasts wall off and isolate the invading substance, and begin their work of destruction upon it. This, according to the theory of Metchnikoff, is a most efficient means of localizing the infection, and is successful unless the number of invading organisms is so great or their multiplication is so rapid that the leucocytes are unable to cope with them, or the virulence of the organisms is so great that a negative chemotaxis results, or the secretion of leucotoxic substances by bacteria causes the breaking up of the wall of the leucocytes and fibroblasts. Lymph fluids traveling from infected areas often contain bacteria. The lymph nodes placed as they are at the most probable portals act as filters to all passing fluids. Numerously arranged, they make impossible the escape of most bacteria under normal conditions. When overtaxed, the leucocytes collect to render them assistance. All lymph which has become impotent upon bacteria and poisonous to leucocytes must be removed by adequate drainage, and must be replaced by lymph favorable to phagocytic action and unfavorable to bacteria. This may be brought about by application of hyper tonic salt solution and sodium citrate to the wound, or in case of deep wounds by pouring the solution in and plugging lightly with gauze. Living cells have the power of approaching and attacking either animate or inanimate foreign bodies in the tissues or of evading them. The former constitutes positive chemotaxis, the latter negative chemotaxis. Most leucocytes especially, and many other cells to a less extent possess this power. The toxicity of bacteria is the cause of this phenomenon. Those possessing high virulence are less open to the attack of leucocytes. If highly virulent cocci are injected into the peritoneal cavity of a rabbit, examination will show very few of these ingested by the cells. If, however, killed organisms or those of low virulence are injected there will be found within the body of the leucocytes large numbers of the bacteria. (Bordet). By increasing the number of leucocytes in a given field, or increasing their chemotactic power, or by decreasing the power of the bacteria to oppose the leucocytes, tissue resistance will be increased. This may be brought about by use of bacterins and vaccines as will be later discussed.

The chief chemical substances which are protective to tissues consist of the agglutinins, opsonins, alexins, and antitoxins. These are contained in the various constituents of the blood, in the lymph and in other fluids of tissues and confer upon these bactericidal or bacteriolytic powers.

The alexins thus contained may exert their influence upon certain bacteria without being exhausted and even after their power to destroy any special class is exhausted they may act in a deleterious manner upon other varieties. Extensive infection may result in a complete destruction of such substance when the body is laid open to unlimited attack by bacteria.

Agglutinins are agents closely allied to the alexins. Their property is to cause clumping of bacteria with loss of motility. As diagnostic agents they are valuable but there is little to show that they are of any therapeutic value.

Antitoxins are substances capable of neutralizing or destroying toxins but having slight if any effect upon the bacteria producing such. They are produced in the blood of suitable animals highly immunized by injecting increasing doses of toxin. The serum of such animals contains the antitoxin which when carefully standardized and preserved is highly efficient as a prophylactic agent.

Doubtless of chief importance as natural protective agencies against wound infection are the opsonins. Capable of therapeutic application for a large number of bacterial species they possess a distinct advantage over antitoxins which are useful in only a limited number of infections. Changes are brought about in the body of an individual by bacterial invasion (disease), such that he is less susceptible to disease than before, or wholly insusceptible. By the systematic injection of bacteria into an individual (vaccination), the same condition may be produced. Agglutinins and bacteriolysins may be in part responsible for this condition, but opsonins are of greater importance. It has been known for a long time that leucocytes have the power of destroying invading organisms. Wright and Douglas demonstrated that this power depended upon the presence of a specific substance (opsonin). In their work they carefully washed leucocytes, suspended them in isotonic salt and added bacteria. After incubation examinations were made and the number of bacteria per leucocyte was determined. They then substituted normal blood serum for the isotonic salt and found an increased number of bacteria ingested. With blood from animals recovered from an infection they found a still greater number ingested. By suspending bacteria in immune serum, washing and then adding leucocytes they obtained the same results they had obtained when the suspension was made in serum, thus proving

that the action of the specific agent (opsonin) is upon the bacteria, preparing them for ingestion by the leucocytes. Experiments further show that the action of the opsonin is specific. That is, a serum which will stimulate phagocytosis for the micrococcus aureus will not stimulate in the same manner for the bacillus coli.

Further it can be shown that this increase in opsonic power is controllable. By using attenuated or killed cultures in given dosage the same condition can be brought about as occurs following recovery from a natural infection. This resulted in the use of bacterins and vaccines. The determination of a proper dosage of bacterins or vaccines to stimulate opsonin production is possible only by observations made upon many individuals with great care. This for the practitioner would be impracticable and costly. As a substitute then for a single dose it has become customary to administer in small and increasing doses. The clinical progress of the disease is to be carefully observed and so long as no untoward symptoms such as local increase of discharge, inflammation, increased temperature, muscular pains, etc., occur and there do occur improved local and constitutional conditions the dosage is to be considered safe and increases may be made at proper intervals.

There are conditions in which the use of vaccines and bacterins is detrimental. Their use is not indicated in all infections even where opsonins can be produced. Their use is worthless in cases where the quantity of bacterial poisons is so great as to exhaust the natural recuperative powers, or where the bactermia or toxemia is so great that the addition of more of the same poisons would only result in the reduction of the natural resistance.

In mixed infections where it is impossible to determine the organism primarily responsible for the condition it may be useless to administer vaccines because of the uncertainty of dosage and the possibility of lowering rather than of increasing the opsonin for the principal organism. By this it is not to be implied that splendid results are not sometimes obtained by administration of mixed bacterins but the possibility of failure is great. Mixed infections in which it is possible to determine the organism of greatest importance may respond to vaccine treatment with the single organism, which removed leaves the tissues able to dispose of all others responsible in a minor way.

Vaccines are either heterogenous or autogenous. The latter are prepared from organisms isolated from the particular case to be treated and are most satisfactory. However the difficulty and consequent increased cost of production make it necessary to use the heterogenous which have their source from other than the patient to be treated.

There are two principal types of organisms which are important in wound infections. They are:

1. Pyogenic.
2. Spore producing anoerobes.

The principal pyogenic organisms are the micrococcus aureus and albus, the streptococcus pyogens, the bacillus pyocyaneus and the bacillus coli. The micrococcus aureus is a spherical gram positive organism which produces a yellow pigment. It is normally present on the skin and hair, in the soil, and in the dust of the air. It flourishes best in the presence of oxygen, hence is common in open wounds. It shows a marked resistance to dessication although it does not remain alive for long periods in this condition. The different strains vary in their ability to resist heat. A temperature of 60° to 70° applied for 30 minutes will destroy most varieties. It shows no special resistance to disinfectants, being destroyed readily by the common ones in the standard strength. On the leucocytes it exerts a marked destructive action, due to the presence of a toxic substance known as leukocidin. There is produced by it also a second toxin, staphylolysin, hemolytic in its action. There is possibly also present an endotoxin which is of importance in determining the pathogenic nature of the organism. The presence of the two toxins has led to the production of antitoxins, but they have not been shown to confer any immunity. Opsonins are readily demonstrated, and seem to be the most important serum constituent for the production of immunity. The micrococcus albus differs from the aureus chiefly in that it produces no pigment and is less pathogenic. The streptococcus pyogenes is not so commonly found leading a saprophytic existence as the other cocci. It is more readily killed than the M. aureus, both by heat and disinfectants. The different strains manifest great differences in pathogenicity and the virulence of a certain strain for a particular animal may be greatly enhanced by passage through that species. Little more is known concerning the mechanism of disease produced by this organism than concerning that produced by the micrococci. The changes caused by it in tissues are usually in those tissues in intimate contact with the organism. Lack of resistance on the part of the tissues seems especially necessary in order that infection may occur. A wide variety of diseased conditions has been shown to be produced by this organism. Principal of these are septicemia, pyemia, erysipelas, cellulitis, tonsilitis, enteritis, peritonitis, pneumonia, arthritis, mastitis and endocarditis. Immunity is chiefly opsonic in character. Antiserum has been produced by systematic immunization of goats and horses, and the results obtained from the use of such serum have been varied. As a prophylactic it seems most serviceable.

The B. pyocaneus is not uncommon as a secondary invader in fistulas, wounds, etc., but is rare as the cause of primary infection. This organism produces the characteristic blue green pus. It produces a true toxin for which an antitoxin has been prepared. Opsonins are produced and many stock mixed bacterins contain this organism.

Of the spore producing anoerobes the most important are B. tetani, B. welchii and B. oedematis maligni.

B. tetani is particularly common in richly manured soil, dust of roads and wherever horse manure is present. It is an organism which requires certain conditions favorable for its growth, chief of which are anaerobic conditions and the presence of foreign material or other bacteria. It is highly resistant to heat and disinfectants when in the spore stage. It produces a toxin which has a special affinity for nerve tissue. The organism localizes for its development and elaborates here the toxin which is absorbed for the most part by the end organs of the motor nerves, and travels to the nerve cells of the central nervous system by way of the axis cylinders of the peripheral nerves. Possibly a part of the toxin may be carried to the central ganglion cells by the blood stream.

Immunity is of the antitoxin type. Toxin, which is produced in artificial media as well as in the body, is utilized by subcutaneous injection into the horse for the purpose of stimulating antitoxin production. Owing to the fact that the toxin has so much stronger binding affinity for nerve cells than for the antitoxin, treatment with the latter after the disease has set in is not so efficient as a curative agent as is antitoxin for diphtheria. It is however, very valuable as a preventive agent when used early.

The bacillus of malignant oedema is one which resembles in many of its morphological and physiological characters the bacillus of tetanus. Tissues at the point of invasion become distended with gas which the organism produces in abundance, and infiltrated with yellowish or reddish serum. Although animals recovering from the disease are found to be thereafter immune, yet no method of artificial immunization has been developed.

The bacillus Welchii another of the gas producing organisms has its natural habitat in richly manured soils. It is an important organism in the production of infection in the human, causing a gaseous edema, with thick, frothy, rusty brown, sometimes almost faecal discharge. Reports of its occurrence in wounds of animals are few. Immunity is of the opsonic type, but systematic immunization has not been developed, the relatively slight pathogenicity of the organism failing to make such advisable.

# Monday Clinic

## (Poll Evil)

H. E. BEMIS.

While we are getting ready for the operation on the case of poll evil in the other room, I would like to say that I have not had time to make a thorough examination of this case or to get a very good history other than that about four weeks ago the owner noticed an enlargement in the region of the poll and thinking it needed opening, took his knife and opened it. So you will see the wound on one side over the first cervical vertebra, but just how extensive the process is I have not determined because the animal is hard to control standing, and I thought we could come to some conclusion after the case had been put on the table, when we can have further discussion.

Now I think you will usually find in these cases the supra-atloid bursa is involved and usually also the ligament which overlies the bursa is necrotic, at least on the lower side, that portion which is in contact with or which lies over the supra-atloid bursa, and of course sometimes the bone is also affected. In some cases we have an ankylosis of the occipito-atloid articulation, but I do not expect anything of that kind in this case because it is apparently recent.

The operation we have been performing here and the one which I think is quite generally accepted as being one of the best operations for this condition, was worked out I think largely by Doctor Williams of Cornell University and others, and consists in resection of that portion of the ligament which overlies the atlas and attaches to the occipital bone anteriorly. In order to resect this ligament an incision is made in the median line extending from a few centimeters anterior to the crest of the occiput, backward over the atlas to a point posterior to the process. This incision extends through the skin, the subcutaneous tissue, superficial fascia and either through the ligament or to one side of it into the diseased process. Then getting under the ligament, as is readily possible in the region of the diseased process, it can be drawn away from the underlying structures so as to avoid any possibility of entering the occipito-atloid articulation in operating, and I think in many cases it is possible to avoid wounding the transverse branch of the occipital artery which is sent across from the artery on one side to its fellow on the other side, uniting the branches, which are found almost in the center of the operating region running under the supra-atloid bursa. In dissecting this ligament from the surrounding structures, I have followed the practice of drawing it upward as much as possible and working toward the

ligament, with the idea of preventing hemorrhage, especially from this one branch, and also avoiding any injury to the articulation, as stated a moment ago.

When the ligament has been isolated from the surrounding tissues on either side back as far as the process extends and a little behind it, then it is divided obliquely from below upward and backward for the purpose of preventing the formation of a pocket at the posterior portion of the wound. I think it is common experience that this is one of the most troublesome things following an operation, and it is with the idea of preventing migration of pus that the incision is made through the ligament from below upward and backward obliquely. Then the ligament is drawn upward, clasped with a pair of heavy tissue forceps and dissected away from its attachment to the occipital bone and any remaining shreds curetted from the occipital bone. A good many operators follow the practice of cutting a groove in the occipital bone, varying in depth from one-half to three-quarters of an inch, the idea being that such a groove will afford better drainage of the process anteriorly when the head is lowered. I have followed that operation myself almost exclusively, but lately have come to the conclusion that such a groove does not help materially with the drainage. It is one of the first regions to fill with granulation tissue, and what drainage may have been established is soon obstructed. It involves serious injury to the bone, and when it is not necessary I do not wish to do it.

You will find that the progress of these cases varies a great deal, according to the extent of the original process, the amount of necrosis of the surrounding tissues, the success you have in establishing complete drainage, and also varies of course with the individuals, not only as to their power of resisting infection and overcoming the effect of the operation, but their power to produce granulation tissue, which varies in different animals. You will find also that some animals will stand with their heads down so that drainage is good, other animals will persist in standing with their heads up. In all cases following the operation it is very important to have the animals fed entirely from the floor so as to keep the head down as much as possible.

The steps of the operation I will take up as we proceed. I always practice having the animals under a general anaesthetic and try to control the hemorrhage as completely as possible. If there is a large amount of inflammatory tissue surrounding the process it is more difficult to control the hemorrhage.

Following the completion of the operation the wound is packed with gauze and the incision sutured except at the anterior end. After twenty-four hours the packing is removed and the sutures allowed to remain as long as they are not ob-

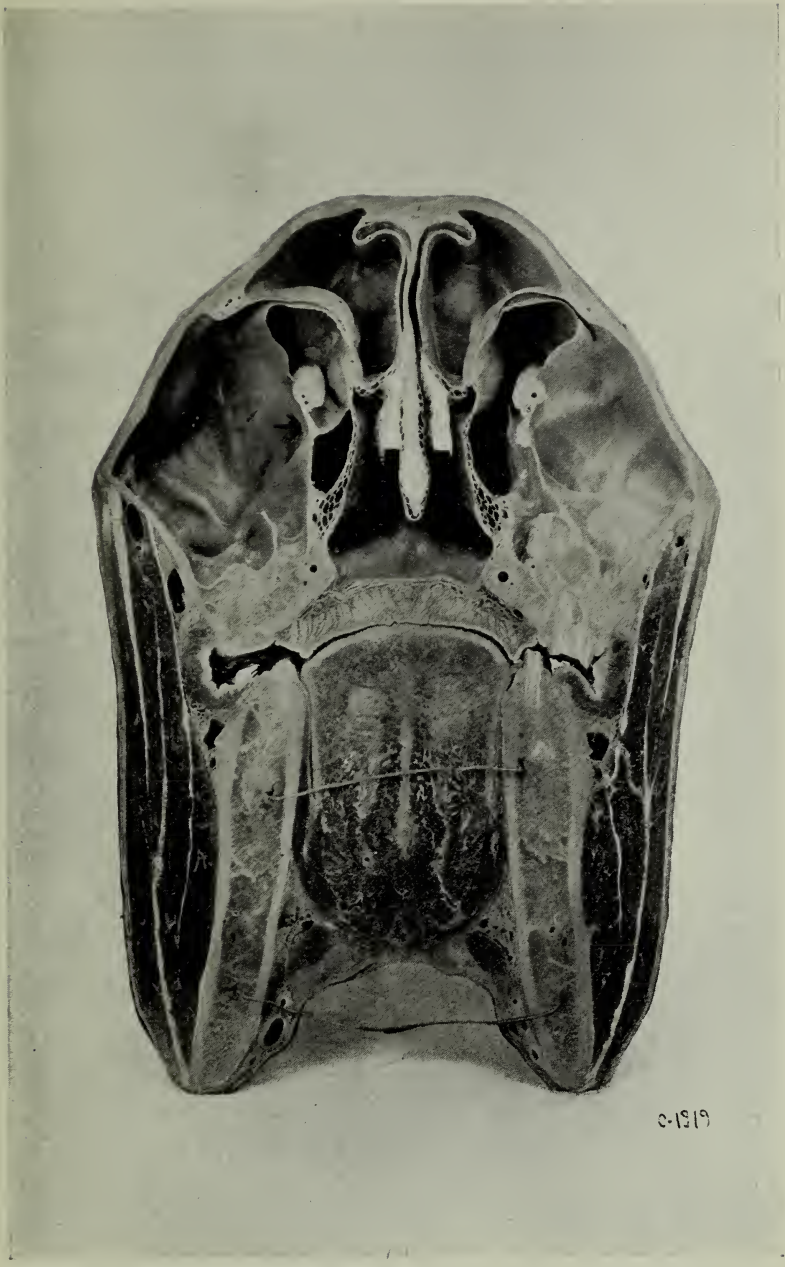


Fig. 108—Cross section of the head showing the plate of bone rising from the floor of the maxillary sinus to support the infraorbital nerve. Drainage of the inner compartment toward the outside may be secured in mature horses by perforating this plate of bone.

structing drainage and are not showing indications of cutting through. As soon as it is seen that they are obstructing drainage or are beginning to cut, they had better be taken out, even though all have to be taken out. Somes cases will heal with at least most of the sutures in place. The more sutures one can leave in place the less gaping will occur and consequently the less scar tissue will form. Healing should take place in from four to six weeks.

## TUESDAY CLINIC.

Operation for Fistula of the Withers.—Dr. Bemis.

Anaesthetic.—Dr. Bolton.

Chief emphasis was laid upon the importance of thorough drainage of these processes under the deep face of the rhomboideus muscle without dividing the deep cervical fascia, thus, avoiding migration of secretions between the deeper muscles of the neck.

## WEDNESDAY CLINIC.

A Demonstration of Nerve-blocking as a Means of Using Local Anaesthesia in Animal Dentistry.—Dr. Bemis.

An animal was confined upon the table and 2 cc of a 5% solution of alypin injected directly upon the superior and inferior dental nerves after the method described and illustrated in the lecture upon diseases of the head, after which, teeth were loosened and removed with little, if any, pain to the animal.

## THURSDAY CLINIC.

A case of lameness in a black driving mare diagnosed as navicular disease, following which, a double low plantar neurectomy was performed by Dr. Bemis. This animal made a complete recovery and was sold a few weeks after the operation for war service in Europe.

## FRIDAY CLINIC.

1. Serum production with demonstration of methods as well as specimens showing lesions of hog cholera by Dr. C. G. Cole.

2. Examination of a case of lameness having the following history:

A seven year old gelding which, when purchased one year previously, had an enlarged stifle.

During the work of corn plowing he was noticed to be unsteady in movement of the hind limbs. Since that time he has

been gradually growing worse until at the present time (Aug. 20th) he is unable to stand for more than a few minutes without leaning against the side of the stall.

Diagnosis: Fracture with displacement of articular head of the femur.

Animal destroyed and diagnosis confirmed. The head of the right femur had been fractured and displaced downward about two inches in which position it reunited. Because of the change in position and the faulty distribution of weight the ischio-pubic symphysis became disunited and the left half of the pelvis displaced upwardly and toward the median line.

3. Examination of a case of congenital ventral hernia. The sac was fully twice the size of a man's head and the hernial ring practically as wide as the base of the sac. Operation was considered to be inadvisable and post mortem showed the large intestine to be present in the sac and greatly dilated but not adherent.

Fig. 109—Fracture of head of femur.

Fig. 110—Congenital Ventral Hernia.

## SATURDAY CLINIC.

Three year old roan gelding which had suffered a gradual filling of the right nasal cavity and sinuses by an inflammatory tumor resulting from infection of the alveolar cavity of the fifth cheek tooth. The tumor and affected tooth were removed and the animal made complete recovery by October 1, 1915.

Operation by Dr. Bemis.

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